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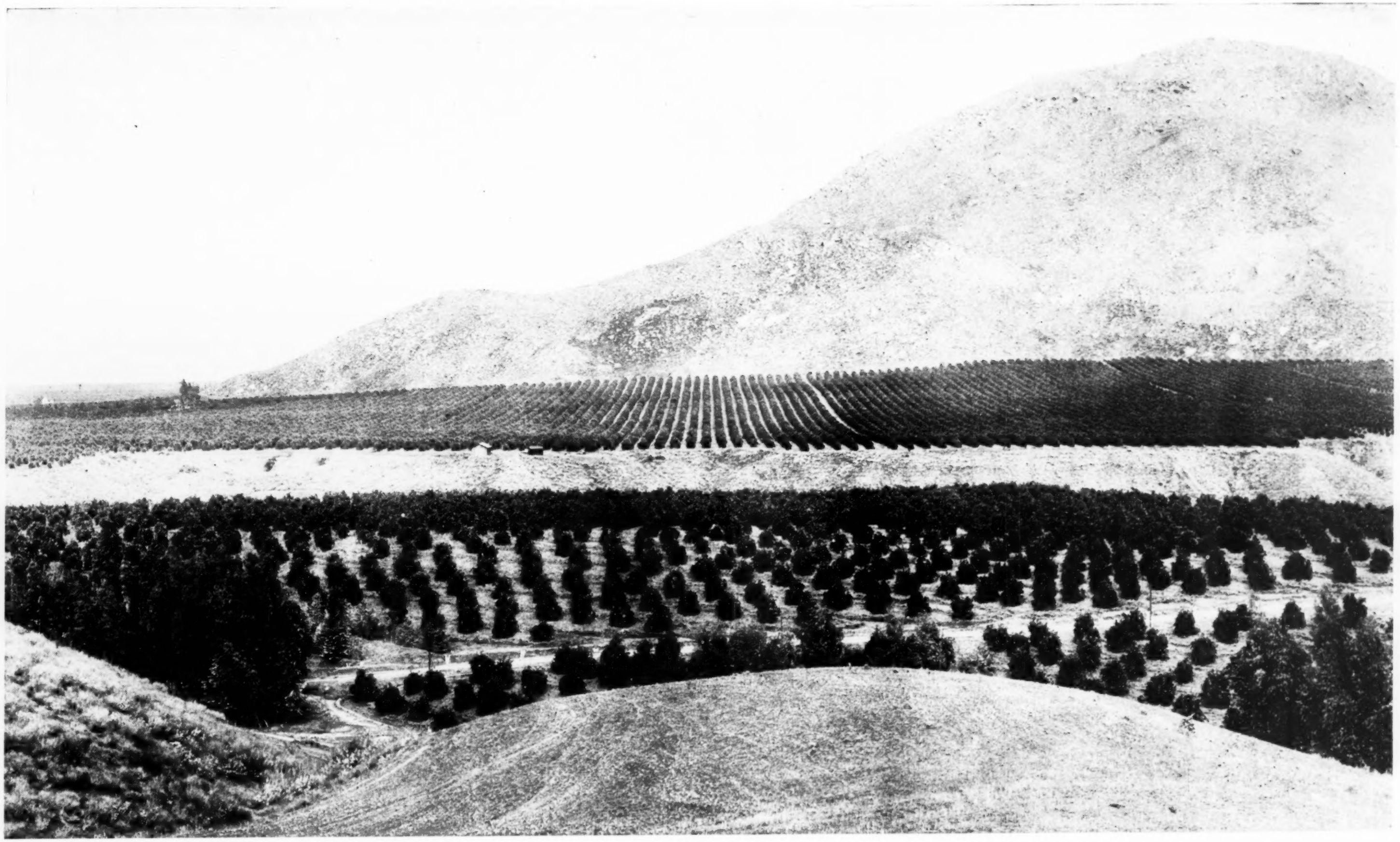

CALIFORNIA GROVE OF WASHINGTON NAVEL ORANGES

The orange industry in California represents one of the most highly perfected and organized horticultural industries in the world, and this grove near Riverside, California, gives a good idea of how the Washington Navel is grown in that state. (Frontispiece.)

WASHINGTON NAVEL ORANGE

Important California Citrus Fruit Originated in Brazil Nearly a Century Ago, Brought to United States in 1869—Comparison of Culture in California and Brazil—Importance of Bud Mutations[1]

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THE Washington Navel Orange is one of the most interesting and important horticultural varieties in existence. The facts concerning its origin and introduction into the citrus districts of the United States and other countries are well established. The development of the culture of this variety on an extensive commercial basis has occurred well within the history of men now living. The recollections of these men concerning its early propagation, methods of planting and culture, are clear and well defined. While many of the men and women who were directly concerned in the introduction of this variety into the United States have passed away, they have, fortunately for posterity, left permanent records of some of their experiences in this connection.

The following paper is an attempt by the writer to bring together the available information concerning the origin and development of this variety. A study of the facts should be of intense interest to all plant breeders and others who are concerned in the development and improvement of our horticultural varieties. The historical data presented in this paper relating to the origin and development of the Washington Navel Orange in Brazil were collected by an expedition sent to that country by the U. S. Department of Agriculture in the fall of 1913, consisting of P. H. Dorsett, Wilson Popenoe, and the writer. The facts mentioned in the discussion of the introduction and development of the navel orange in the United States have been secured from papers and reports in the possession of the U. S. Department of Agriculture, and from first-hand interviews with some of the men and women in southern California who took part in this work.

ORIGIN

The Washington Navel orange originated at Bahia, Brazil, as a bud sport from the Portuguese variety of orange, *laranja selecta*, or the "select orange." This variety was undoubtedly introduced by the Portuguese into Brazil very soon after the colonization of that country. According to V. A. Argollo-Ferrão,[2] the navel orange appeared as a bud sport of the *laranja selecta* variety and was discovered and first propagated by a Portuguese gardener at Bahia in 1822. This account of the origin of the Bahian navel orange was confirmed by all other available information. The fathers or grandfathers of some of the orange growers at Bahia were personally acquainted with the circumstances connected with the origin and propagation of this variety and this knowledge was handed down to their sons and grandsons.

From the first, the seedless fruits of the navel orange trees were highly prized by the Bahians. The superior qualities of these fruits attracted general attention. The growers of the parent *laranja selecta* variety, recognizing the importance of the seedless navel fruits, planted that variety exclusively, as soon as trees were available for this purpose. At the present time the Bahian navel orange has practically supplanted all other varieties of oranges

[1] Read before the twelfth annual meeting of the American Genetic Association on August 3, 1915, at Berkeley, Cal.

[2] Inspectoria Agricola do 11° Districta, Bahia, Brazil.

grown in Bahia, with the exception of a sour or bitter variety, called *laranja de terra* (*Citrus vulgaris* Risso), which is grown for the production of seeds used for raising stocks. At Rio de Janeiro, commercial orchards of the *laranja selecta* variety are still cultivated by some of the farmers in agricultural districts near the capital. In the first orchard of this variety visited by the writer, a tree was found having a limb sport bearing typical navel orange fruits, while the remainder of the tree bore the regular seeded *laranja selecta* orange. Other similar cases were observed, tending to confirm the history of the origin of this variety as related by the Bahian orange growers and others. The navel orange variety in Brazil is called *laranja selecta de umbigo*, or the "select orange with the navel." This name in itself tends to confirm the established history of the origin of this variety.

NAVEL ORANGES IN BRAZIL

The Brazilian expedition found that the principal navel orange district in Brazil is that of Bahia. A few trees of this variety were found growing in the orange groves near Rio de Janeiro. We were informed on good authority that limited plantings have been made in some interior districts of Brazil, but in no case has the development of the industry reached such extent or importance as in the Bahian district. We found growing at Bahia about 50,000 bearing navel orange trees and about an equal number of trees which had not as yet reached the bearing age. A typical tree is shown in Fig. 1. Inasmuch as the trees are usually planted at the rate of about 100 per acre, there were about 1,000 acres of bearing and non-bearing navel orange trees in the Bahian district.

The development of this industry has been encouraged by the Brazilian Government, and particularly by the city of Bahia. We were told that within this municipality there are about 35,000 acres of land suitable for planting oranges. The city has established an experimental farm for the purpose of investigating methods of propagation, culture, and handling oranges for the benefit of citrus growers. Liberal inducements are given to prospective planters in the way of long time, low rentals and facilities for transporting and selling the crops. A strong effort is being made by the municipality of Bahia to encourage an export trade, particularly to the larger cities of South America, so that the existing demand for this fruit can be supplied.

Under present conditions the culture of the navel orange at Bahia is a profitable undertaking for the growers, the fruits retailing in the city of Bahia for an average of about 3 cents each. A typical Bahian navel orange is shown in Fig. 2. The expense of clearing the land, planting the orchards, and bringing them into bearing is frequently made up by the profits from the culture of mandioca[3] between the rows of orange trees. The bearing orchards are cultivated by scraping off the weeds from one to three times a year with a heavy hoe, or "enchada." About the only fertilizer used is barnyard manure. All of the growers of the larger orchards maintain dairies in connection with their farms, mainly for the purpose of securing manure for use in their orange groves. This manure is carefully conserved and is usually applied by burying it in heaps between the trees; on hillsides it is buried some distance above the trees, usually under the drip of the branches. It was the unanimous testimony of Bahian orange growers that mottle leaf and chlorosis of citrus trees could be cured by the liberal use of manure. Insect enemies and fungus diseases are not controlled artificially except in the case of ants. The ant colonies in the orchards are destroyed by digging them out or more recently by fumigation.

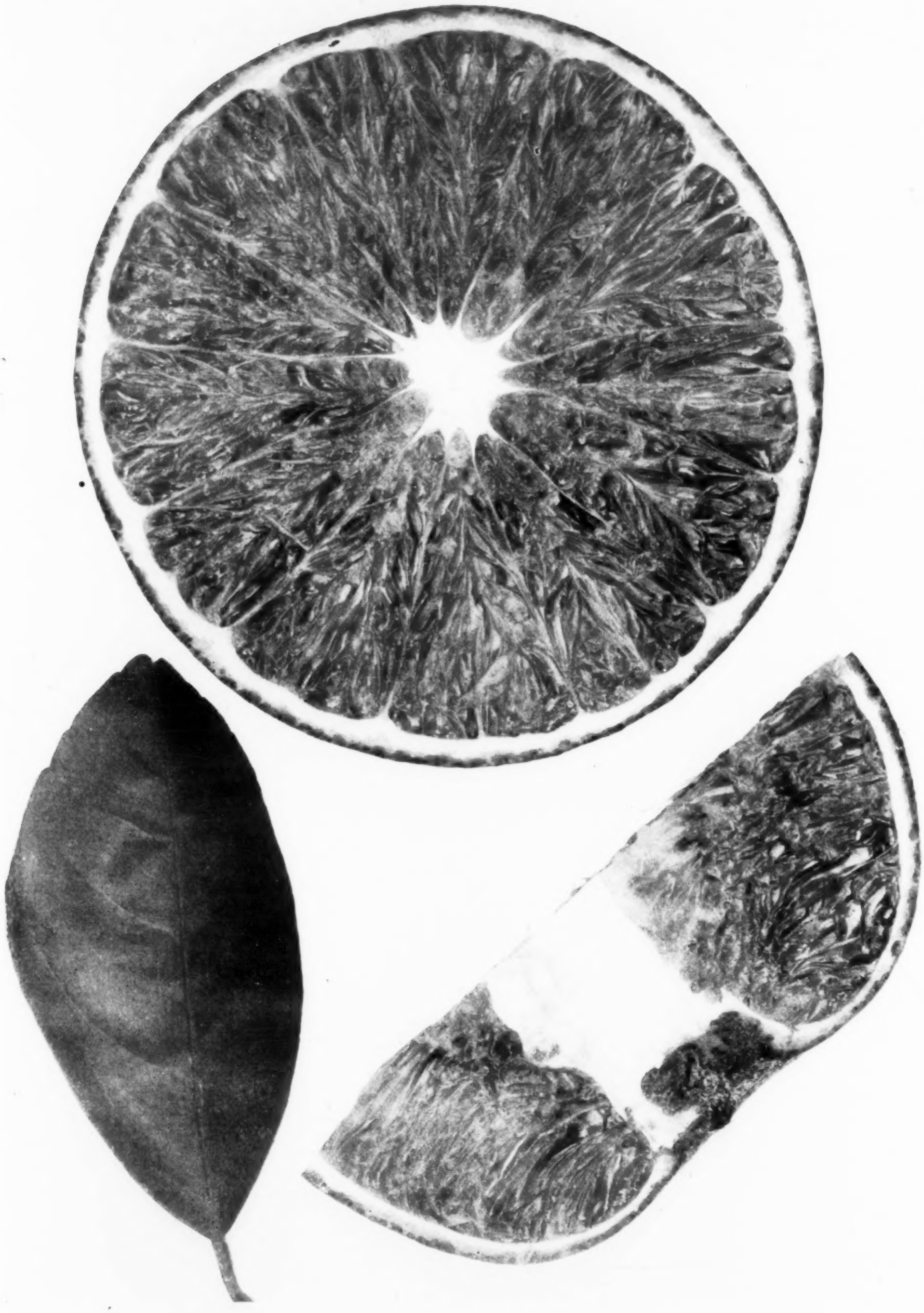
[3] Mandioca is the Brazilian name for the manioc or cassava (*Manihot utilissima* Pohl., Euphorbiaceae), one of the important food plants which is native of South America. It is widely cultivated for its roots, which sometimes weigh as much as 30 pounds and are 3 feet long. They are ground up, and the bitter, poisonous juice which they contain is expelled by drying on heated plates; the resulting product is known to almost every one in the United States under the name of tapioca.

NAVEL ORANGE TREE AT HOME

Typical specimen in the grove of Col. Frederico da Costa, Matatu, Bahia, Brazil. The navel orange of California was brought from Bahia, where it is believed to have originated as a bud sport about 1826. (Fig. 1.)

The oranges are usually picked by men climbing the trees, breaking off the spurs to which the fruits are attached, and dropping them to the ground. They are then collected into heaps; assorted into two grades, one consisting of the large, and the other of the small, fruits. The fruits are then loaded into boxes or packs and carried on horse or mule-back to the markets; or in some cases the buyers come to the orchards from the city and carry baskets of the fruits on their heads to the city. The steamships that call at Bahia take a considerable portion of the crop for use on their tables. A small quantity of navel oranges is now exported to Rio de Janeiro, Buenos Aires, and other South American cities, but not enough, we were informed, to supply the demand in those cities for this variety.

The navel orange orchards at Bahia are located on the higher lands and are given no irrigation—the annual rainfall at Bahia is about 50 inches a year, so that under normal conditions irrigation is not needed. We were told that in dry seasons the crops were comparatively light, while the best crops are produced during the wet seasons. The principal crop ripens in May, June and July, a period corresponding to our winter or the California rainy season. Another crop ripens in December, January and February, while on some of the trees ripe fruits are found the entire year. Our observations in this connection led us to the conclusion that



NAVEL ORANGE OF BAHIA

This fruit is a good sample of the navel orange as it still grows at the place of its origin. The skin is relatively thin and the navel rudimentary. Its quality is very good, although investigators differ on the question of whether the navel orange at Bahia is a fruit superior to the navel orange of California. (Fig. 2.)

this habit of fruiting was characteristic of certain types of the navel orange, one type having the habit of ripening its fruit in the winter, another type bearing ripe fruits in the summer, while a third type bears ripe fruits throughout the year, similar to the habit of the Eureka variety of lemon in California.

INTRODUCTION TO UNITED STATES

The Bahian navel orange was introduced into the United States through the efforts of the late William Saunders, Horticulturist and Landscape Gardener for that division of the Patent Office corresponding to the present United States Department of Agriculture. In his reports on this project, he mentions the fact that he learned from a woman correspondent of the existence of a seedless variety of orange at Bahia, about 1868. Through correspondence with the American consul at Bahia, Mr. Saunders secured a shipment of the seedless orange trees, but during the long voyage from Bahia to New York the trees died. Mr. Saunders again wrote the American consul and asked for another shipment of these trees, giving minute directions for the packing of them and their care in transit. Preparatory to the arrival of this second shipment, Mr. Saunders secured some seed from oranges in the Washington market and grew seedlings in the Government greenhouses. When the second shipment of trees arrived, they were in poor condition, but some buds were found to be alive: these were transferred to the seedlings in the greenhouse and a number of orange trees were successfully grown in this manner.

A former neighbor of Mr. Saunders in Washington, residing in Riverside, Cal., Mrs. L. C. Tibbetts, learning of the success of this introduction, wrote to Mr. Saunders asking for some of the trees. When the trees were ready for distribution in 1873, two were sent to Mrs. Tibbetts and most of the remainder to Florida, which was thought to possess more nearly ideal conditions for the growth of this variety. The two trees received by Mrs. Tibbetts were planted in her dooryard and were carefully tended by her personally until they came into fruiting. When the first fruits ripened on these trees, Mrs. Tibbetts invited her neighbors to assist her in testing them. These neighbors and Mrs. Tibbetts decided that this orange was superior in many respects to any then grown in Southern California and made every preparation to propagate this variety as rapidly as possible. Further experience confirmed the judgment of these pioneers, and as a result, the navel orange soon achieved a wide reputation on account of its superior quality, seedlessness, and other valuable characteristics. The trees sent to Florida proved to be somewhat unsatisfactory, particularly on account of low production in comparison with other varieties then grown there. While a small acreage of navel oranges is cultivated in Florida, this variety has never achieved any great commercial success or importance in that State.

ORIGIN OF THE NAME

Mr. Saunders distributed the navel orange trees under the name of the Bahian Navel orange, marking the origin of this variety in Bahia. The first important commercial orchards planted in California were grown near Riverside, and for a time the variety was known locally as the Riverside Navel orange. Later the successful introduction of this variety into other districts in California led to a general discussion of an appropriate name for the variety and at a public meeting called for this purpose, the growers united upon the name of the Washington Navel orange for the variety. This name was adopted in recognition of the fact that the variety was introduced and the first trees in this country were propagated by the Agricultural Department at Washington, D. C.

DEVELOPMENT OF THE INDUSTRY

The general introduction and development of the navel orange industry in California has occurred within the last forty years. From the two original trees planted by Mrs. Tibbetts in 1873, which are still living and producing fruits at Riverside, the industry has grown in California until at the present

NAVEL ORANGE OF CALIFORNIA

The skin of the California product is thicker than that of the Bahia fruit, the navel is much more highly developed, and the fruit has also a much higher and warmer color, externally, than does the orange of Bahia. Some of the changes that have taken place in it, during the forty years since it was introduced, may be ascribed to differences in climate and soil; others are imputed to further bud mutations. (Fig. 3).

time there are about 100,000 acres of this variety cultivated in the State. A typical Washington navel orange is shown in Fig. 3; a typical productive form Washington navel tree is shown in Fig. 4; and a typical Washington navel orange grove near Riverside, Cal., is shown in the frontispiece. The crop of navel oranges is about 25,000 carloads of fruit each year, containing about 10,000,000 boxes of oranges. From California, trees of this variety have been sent to Japan, Australia, South Africa, and other foreign citrus districts. In those regions the variety has become commercially important and its culture is being rapidly extended, so that it is becoming one of the leading citrus varieties of the world. The Washington navel orange in California has been the foundation upon which the citrus industry as a whole has been developed.

METHODS OF PROPAGATION

The methods of propagation of the Washington navel orange in California are similar in many respects to those practiced at Bahia. In California the variety is usually budded upon stocks from the Mission Sweet Seedling orange. In some districts it has been propagated upon stocks grown from grapefruit, the Florida sour orange, and the Florida rough lemon seeds.

TYPES FROM BUD MUTATIONS

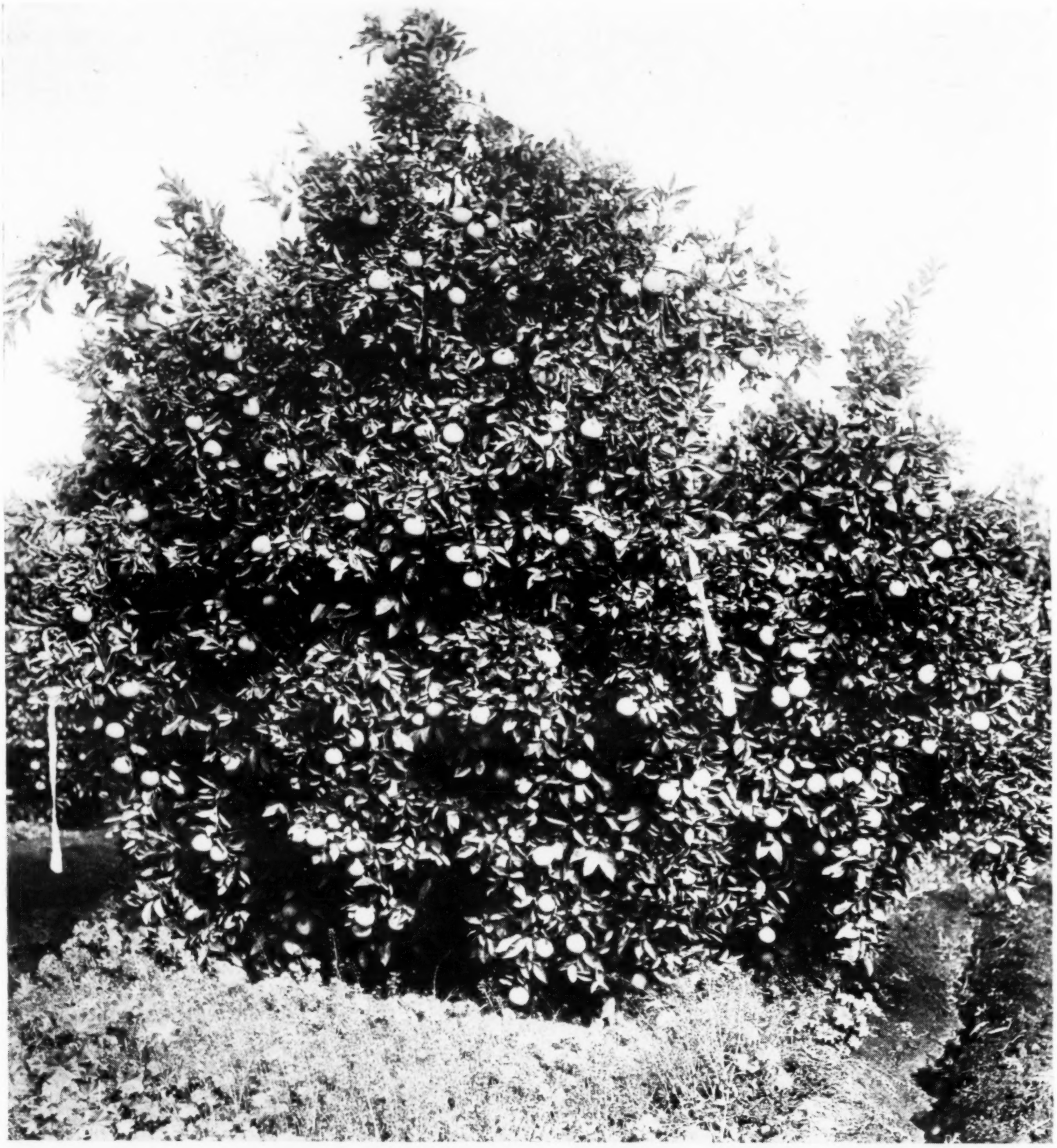
In 1909 the writer began a series of observations on the behavior of this variety under different soil and climatic conditions in California. In the study of these trees, it was found that numerous diverse types of trees and fruits existed. Some of the striking types of trees were distinguished by their habits of growth, density of foliage, and other easily discernible characteristics. A close study of some of the trees disclosed the fact that they bore characteristic fruits. The variation in these types of the Washington navel orange, both as regards trees and fruits, was so marked that it was thought for a time to be due to a mixture of varieties. Later it was discovered that frequently trees grown from a single navel orange bud produced several characteristic types of fruits. In some cases this variation was found to occur as limb sports, in which case both the fruits and foliage on these sporting limbs were characteristic of the types to which they belong. In other cases these variations were found as single fruits.

IMPORTANCE OF TYPES

Systematic investigation of this subject was begun about this time for the purpose of discovering the extent and importance of the diversity of types arising from bud mutations. Plots of about 100 trees each were selected in representative orchards and careful performance records secured from each tree in these plots. After six years' systematic study, conclusions can be safely drawn as to the significance of bud mutations and the importance of the types of the navel orange originating from these mutations. It has been proven that the diverse types of the navel orange existing in the California orchards have originated from bud sports. The trees of these types have characteristic habits of growth and the fruits borne by these trees are of very widely differing commercial value.

FREQUENCY OF BUD MUTATIONS

The occurrence of these diverse types is very much more frequent than has heretofore been supposed to be the case. They are of great and vital importance to the growers from a commercial standpoint. One of the characteristics of some of the unproductive and undesirable types of trees is unusual vigor of growth. Frequently these trees stand out in orchards several feet in height above the neighboring trees and have a spread several feet in excess of that of the standard tree. These inferior trees also frequently produce an unusual number of so-called suckers, or very vigorous vegetative growth, which has heretofore been highly prized for propagation. As a result of this condition, there is little doubt but that in the successive propagations of the past years, an increasingly large proportion



CALIFORNIA NAVEL ORANGE TREE

The culture of the crop in southern California is in most respects very markedly different from that in Brazil. The trees usually get better care, more fertilizer and abundant irrigation, and therefore are likely to produce a larger yield than those in Brazil. (Fig. 4.)

of the trees have been propagated from the more vigorous growing, and as a matter of fact, least desirable type of trees for fruit production, both as regards quantity and commercial quality of the crop. In other words, there has been a steady deterioration in the characteristics of production of the variety from the propagation of these inferior and undesirable fruiting types.

Performance records of typical trees of the eleven common types of the Washington navel orange under comparative conditions for six years have established fairly well the behavior and the value of the trees of these types. The undesirable types, without exception, have been successfully top-worked, using budwood from select trees of the best types. The select

"AUSTRALIAN" NAVEL ORANGE

This peculiar form of the Bahia Navel seems to be the product of a bud sport or mutation similar to the one that produced the original seedless navel. The branch here shown is from a standard Bahia Navel orange tree in the grove of Col. Frederico da Costa, Matatu, Bahia, Brazil; similar specimens can be found in almost any part of the world where the variety is grown. On the whole, this "Australian" mutation is inferior to the standard type which produces it, and wise growers therefore do not propagate from buds of limbs bearing this sort of fruit. (Fig. 5.)

trees of the best types have also been topworked with budwood from the undesirable types, successfully demonstrating without any possibility of doubt that it is possible to transfer type characteristics from one tree to another by the use of buds selected on the basis of performance records. Propagations have been made from all of the common budsports and these propagations have been so successful as to prove the fact of the origin and development of these diverse types from bud mutations.

At the present time there are extensive commercial individual tree performance records being kept by navel orange growers in California for the purpose of locating the drone trees of the undesirable types. These inferior trees are being rapidly topworked, using budwood from trees selected on the basis of performance records. Some of the leading nurserymen have adopted the principle of propagation from select trees, propagating only from those trees producing large, regular, and valuable crops of the standard or best type of fruit as shown by actual performance records. It has been commercially demonstrated in this way that a valuable type of the navel orange can be isolated through bud selection based on performance records.

It is also believed as a result of the

evidence accumulated in the course of these observations, that the variation in this type can be controlled by bud selection, so that by this means the variety can be conserved, maintained, and improved.

In the consideration of the practical problem of maintaining the navel orange variety by bud selection, it has been found necessary not only to select trees from definite individual tree performance records, but also to make limb selections as well. This is done by cutting the budwood from the select trees with the ripe fruits attached and using only budwood from the limbs which produce the typical or standard Washington navel orange fruits. This budwood is of the preceding year's growth and while it is of small size, has been successfully used commercially. The buds from this source have been found to produce equally good if not better trees than those propagated from the larger and more rapidly growing wood.

TREE RENEWAL

Of the observations made in the navel and other orange districts of Brazil, one of the most interesting to the writer was the method of tree renewal practiced by the orange growers. We found existing a general belief that after fifteen or twenty years orange trees became unproductive and unprofitable. In such cases the tree tops are cut off and new tops grown from the old trunks. In the case of badly diseased and dying trees, they are cut back severely, sometimes to a point just above the bud union. Where the trees were in fair condition of vitality but decadent, only the smaller limbs are cut off, leaving the main limbs as a framework for the growth of a new top. The amount of tree top cut off is governed by the condition of the trees. The renewed trees were found to be surprisingly healthy, vigorous-growing, and productive. Many of the orange growers claimed that the fruits borne by these renewed trees were of better quality than those borne by original trees.

In consequence of this practice of tree renewal, no very old navel orange trees were found; the oldest was said to be about 40 years of age. However, in some cases, evidence was discovered where such trees had been renewed as many as four times, indicating that the trunks were from 60 to 80 years of age.

The method of tree renewal practiced by the Brazilian navel orange growers is chiefly of interest in that it tends to confirm the soundness of the principle of pruning based on the systematic renewal of the fruit-bearing wood in citrus trees.

BUDDING

Another interesting practice observed in the Bahian navel orange districts was the budding of stocks set in permanent orchard places. While the general method of propagation followed in the past at Bahia has been that of the ordinary nursery, the majority of the newer orchards were found to be propagated by budding the stocks in place. Certain advantages for this method of propagation are claimed by the Brazilian orange growers: *e.g.*, a more rapid growth of the budded tree, earlier fruiting, and greater resistance to diseases, as compared with the ordinary transplanted nursery trees. The stocks are budded higher than is the usual practice in this country—15 or 20 inches above the ground, and are usually about two years old when budded. The budding is done at all times of the year, but is said to be most successful during November, December, and January, the spring and summer seasons in Bahia. A shield bud is used as a rule, the budsticks being about the same size as the stocks to be budded.

BUD VARIATIONS

Bud variations were found in the Bahian navel orange, but apparently are not so frequent as in the California Washington navel orange trees. Distinct types of trees, as shown by habit of growth and other characteristics, were observed in all the orchards examined. On individual branches, leaf variations were very frequent. For instance, the variation of the petiole was particularly noticeable. The petiole

of neighboring leaves varied from broadly winged to wingless, winged on one side and wingless on the opposite side, very small to very large, and from one to three sets of wings. On one of the standard type Bahian navel trees, a sporting branch was found bearing typical flattened and wrinkled so-called Australian navel fruits, as shown in Fig. 5. One entire orchard of several thousand trees was observed planted to the Australian type of navel orange.

In one orchard we found well-established instances of reversions of the navel to the selecta variety of orange. In this orchard the owner, Col. Luiz de Suze Demetrio, one of the leading navel orange propagators of Bahia, told us that three typical fruiting *laranja selecta* trees in his orchard were grown from buds cut from a navel orange tree and propagated on sour orange stocks by himself.

Variability in time of ripening fruits, size, shape, navel characters, color, thickness of rind, amount of juice, character of rag, quality, and other characters, were particularly marked. To the writer, the most interesting observation in this connection was the variation in time of ripening the fruits, indicating the possibility of controlling this character in some measure through bud selection.

Most of the types of navel oranges found in California were observed in the orchards at Bahia.

It may be of some interest to note that the writer has found several of these typical budsports in the fruits produced by the two parent Washington navel trees at Riverside.

In a consideration of the factors involved in the successful development of the navel orange industry in California, the work of the pioneer orange planters must not be overlooked. These men and women settled in a desert. All of the problems incidental to bringing under cultivation this arid land were met with sublime courage, intelligence, and resourcefulness. Most of the settlers were fresh from plentifully watered, fertile lands and established conditions of eastern agricultural sections. The taming of the sagebrush lands, the development of water for irrigation, the discovery of new methods of culture to meet new conditions, needed iron determination and strong faith. How well these pioneers succeeded is shown by the wonderful orchards, perhaps the most perfect of all time, the beautiful homes nestling in the orange groves, and the highly cultured people who are enjoying the results of the efforts of the pioneers. It has been said that the man who causes two blades of grass to grow where one grew before is a public benefactor. What can we say of these pioneer orange growers who caused beautiful and useful orchards to grow where nothing grew before?

Berkeley Meeting of A. G. A.

More then 300 persons attended various sessions of the twelfth annual meeting of the American Genetic Association at Berkeley, Cal., August 2–6.

Two general sessions were held, while those interested in plant breeding met in three sessions and eugenics had one session. The program of every session was crowded.

As many of the papers as possible will be printed in the JOURNAL OF HEREDITY; the rest will appear in various other publications to which they seem most adapted.

It was decided to continue meeting in connection with the American Association for the Advancement of Science.

A Committee on Nomenclature was appointed by the presiding officer, Dr. E. B. Babcock, consisting of Herbert J. Webber, Chairman; R. Ruggles Gates, George H. Shull, W. E. Castle, Raymond Pearl, H. S. Jennings and Paul Popenoe.

NEW LIGHT ON EUGENICS

Psychologists' Study of Unconscious Phenomena Convinces Them That Many Traits of Adult Are Due to Impressions on Early Life, and Not to Heredity—Weakness of Some Eugenic Research[1]

SAMUEL C. KOHS
Psychologist, House of Correction, Chicago, Ill.

THE purpose of this brief paper is not to present a new, fantastic theory, but rather to sound a reasonable note of warning to some of our over-confident friends who are advocating a eugenic program based on slippery and insecure foundations. In this age of hyper-enthusiasm some of our fellow-workers are inclined to permit their theories and ideals to loosen their hold on the facts. Both eugenists and psychologists must be extremely careful not to forget that in both fields we are still dealing with "elementa." The amount of data which can be made of practical service is in some fields very meager. We must not permit our hopes to run riot with our facts.

The recent developments of genetic science have again brought to the fore, after a more or less prolonged period of exile, the view of the inheritance of acquired characters. This rejuvenation is receiving a great deal of acceleration, especially among psychologists, by the wider and wider acceptance of Semon's mnemic theory. The followers of Semon claim that ontogeny is a mnemic phenomenon, evolution depending on a change in ontogenetic rhythm (8, p. 387). According to this view nerve cell and germ cell both possess the property of being impressionable, the latter, of course, to a much lesser degree. The *engram* is the unit of impression, many of these being associated into various different groups, the whole completed system being called the "mneme," a Greek term equivalent to "memory." It is claimed that experiences, habits, will leave their traces upon the organism, the germ plasm only being fundamentally affected after a vast number of reinforced repetitions. The "imprint" having been made, later generations will show changes either in structure or function.

In this connection it is of interest to note the following remarks of Jennings (18): "As a material, potentially visible organism, I, like the infusorian, have been in existence ever since the race that developed into human kind began. And this, for each of us, is not a figure of speech, but the plain literal truth. An unlimited microscopist could have followed with his eyes my course, and your course, down through countless ages, never losing sight of the material organism for an instant. . . . I was in actual material existence as a living organism, and indeed thousands or millions of years old, when the pyramids were built, and my unlimited microscopist could give my history from that time to this without a break. What marks has that long history left on my personality and character?" (903–904.) It is this phylogenetic aspect we must keep in mind in studying the heredity of character and personality.

UNIVERSAL ANCESTRY

"Scientists have calculated that each of us of course has thousands of ancestors, and that frequent crossing of ancestral lines has occurred, so that practically every individual living today has among his ancestors *every individual* of the race who lived 5,000 years ago. So the ancestry of the race is practically

[1]Read before the twelfth annual meeting of the American Genetic Association at Berkeley, California, August 3, 1915.

common to all, hence the uniformity of the more elementary feelings and tendencies of the race. Each and every individual is heir to *all* the experiences of past generations" (Atkinson (2), p. 98–99).

With this feeble attempt at reorienting ourselves to the truly wide aspect of inheritance, we come to a weak spot in many a positive eugenic program. There is a tendency on the part of some to include in the list of hereditary characters certain mental, emotional and moral traits which seem to be the peculiar possession of particular families. The hereditability of the following have been maintained by various authors: tact, power of expression, lying, nomadism, endurance, stubbornness, bad temper, sentimentality, good judgment, morality, character, industry, criminality, affability, left-handedness, antipathy for physicians, fear of water, disgust for certain articles of food—*e.g.*, cheese. Heymans and Wiersma observed that parents and offspring resembled each other, among other things, in ardor, impulsiveness, resolution, persistence, generosity, temperance, wit, patience and industry. Davenport enumerates talents in music, art, literature, mechanics, invention, mathematics; the degree of sensitivity, quick or dull, keen or poor; the type of disposition, cheerful or melancholic; selfish or altruistic; conscientiousness or liability to shirk. "These characteristics," he says (10), "are inheritable; they are independent of each other, and they may be combined in any desirable mosaic" (p. 6). Crzellitzer's list of heritable traits includes ability in music, sculpture, painting and mathematics; thriftiness, temperament, liberality and military ability. He quotes the work of Fürst and Jung and their observations of family resemblances by means of the association-reaction method. But what they proved was *not* that certain common ideas or attitudes are inherited, but rather that developed family "complexes" exist. This question will be further elucidated later. Besides those characteristics already mentioned, Josefovici adds diplomacy and ability in science.

Pearson found such qualities as vivacity, conscientiousness, popularity, temper, introspection or self-consciousness, and assertiveness, to run in families. This may be coupled with the following interesting statement made by Davenport (9): The "boldness, swiftness, certainty of manipulation and that precise knowledge which belong to the great surgeon are not due to himself, but were, in their elements, antecedent to him. He could not help his valuable innate qualities, his knowledge is largely a heritage of the past, his education has been possible because of his educability and because of preexisting knowledge" (p. 38). One wonders how close Davenport came to saying that information and dexterity acquired in one generation are transmitted in the next.

WEAK POINTS IN RESULTS

Most of the above studies are of doubtful value because of any one or more of these reasons:

(1) Inaccurate tools with which to measure the ability or capacity.

(2) Amateur field-workers.

(3) The use of the questionnaire method.

(4) Where more than one field-worker was necessary to obtain the data, differences in the individual standards of the field-workers vitiated the results.

(5) Being told for what to look, and possessing the popular conceptions regarding the inheritability of all sorts of traits, it is only just to assume that many of the assistants very easily found what was not there.

(6) The study of character and personality is still in its infancy. To assume that certain peculiarities are due to the presence or absence of specific determiners can, in our present state of knowledge, hardly be substantiated by actual facts.

(7) Some students approach the problem of the inheritance of *mental* traits fresh from the biological laboratory. Without hesitation they will assume, for example, that the overzealous care of one's dress is a unit character, recessive to all appearances, acting in

Mendelian ratio, similar to hair color in certain animals.

Thorndike aptly remarks (36): "One fears that Professor Pearson may next produce coefficients of correlation to show that the political party a man joins, the place where he lives, and the dialect he speaks, are matters of pure inheritance uninfluenced by family training" (p. 242). It is due to these conceptions that it is so difficult to eradicate such false terms as "born criminal," "royal blood," etc.

One great weakness of all these studies has been that all have remained satisfied, it seems, in their belief that conscious phenomena presented to them the complete picture of the psyche. Psychologists generally are beginning to recognize more and more that consciousness is by far the less important, and that the great storehouse for *motives* to action is the unconscious.

"There is much of the cave-man even in the most cultured individual, which comes to the surface when opportunity presents itself and environment supplies the stimulus. Civilization is only skin-deep,—culture is only superficial. Beneath the thin veneer of our civilization lies the great mass of the race experience with all its primitive emotions, tendencies and impulses" (27, pp. 96, 97).

UNCONSCIOUS ACTIVITY

It might be well to cite some opinions on the unconscious at this point. In a recent book by Holt (17) we find the following: "Experimental psychology, then, should relinquish its fetish of introspection, at least until a great deal has been learned about the simpler conscious processes which introspection wots not of. . . . But the greater region lies unexplored by psychologists: it is those lower responses of the nervous system which psychology has hitherto been pleased to call 'unconscious' reflexes and automatisms, that a sound scientific instinct should select as being the simplest and hence the elementary processes of consciousness, out of which the more complicated processes are compounded,—even at last the self reflective" (p. 200).

Atkinson (27) quotes Sir Wm. Hamilton, who states: "I do not hesitate to affirm that what we are conscious of is constructed out of what we are not conscious of—that our whole knowledge in fact is made up of the unknown and incognizable. The sphere of our consciousness is only a small circle in the center of a far wider sphere of action and passion, of which we are only conscious through its effects. . . . The fact of such latent mental modifications is now established beyond a rational doubt; and on the supposition of their reality, we are able to solve various psychological phenomena otherwise inexplicable" (pp. 13, 14). This is in line with Stanley Hall's frequent remark that the psychic life may be compared to a floating iceberg: that which is visible is the conscious; and easily, nine-tenths of the whole mass remains submerged, unconscious. And it is being daily verified that by far the major portion of our mental life never enters the realm of consciousness. We would all be sad wrecks in but a very short space of time were all the mental activity of each successive moment to project itself into our conscious field.

In our studies of mental heredity we have placed consciousness and conscious phenomena on too high a pedestal. Ladd and Woodworth in their "Physiological Psychology" emphasize time and again the enormous handicaps which beset one in attempting to inquire into the elemental factors which go to make up our complex mental states, when either introspection or objective experimentation is used as the analytical instrument.

How dangerously simple then do some of our confreres make mental traits!

DIFFICULTY OF INVESTIGATION

Leibniz (21) was near stating the problem accurately when he said that "petites perceptions" determine our will fiats. Of course, interpreting his statement in modern terms we would say that unconscious ideas, constellations and complexes are some of the chief motivating factors of conduct.

Regarding the nature of the uncon-

scious it was Richard Herbetz (16) who made the remark that "we do not know *what it is*, but only what it *does*, and we do not know *how it does what it does*" (p. 217). But despite our lack of knowledge as to its exact nature, we do know quite definitely and certainly that the unconscious exists and that it is a potent force in directing behavior.

The Freudians and those closely allied to them have uncovered a large number of mental mechanisms whose roots lie in the subconscious. Data first obtained in gross form from those mentally disturbed were found to apply quite as well to people whose psyche was in normal activity. And the great contribution of the Zürich school to the psychology of today has been the discovery of the existence of the complex and the explanation of how it functions. Previous to this time all we could do was just to make disconnected observations such as that of Le Bon in his "Psychology of the Crowd:" "Behind the avowed causes of our acts there undoubtedly lie secret causes that we do not avow, but behind these secret causes there are many others more secret still, which we ourselves ignore. The greater part of our actions are the result of hidden motives which escape our observations." But now we know that the complex, once it is formed, becomes a potent, dynamic unit, and that some of these "blind impulses to action" are merely the inevitable result of its existence.

A complex, simply defined, is an associative arrangement of specific mental data, strongly tinged emotionally. Complexes may exist in the realm of the conscious, but are of as great, if not of greater, significance, when they sink below the limen of consciousness. Education, environment, home influences, exceptional experiences, age, sex, race, religion, certain hereditary predispositions, are among the most important factors determining the type, number and trend of one's complexes. (See 20, p. 548–554.) The recent research of psychoanalysts, whose testimony and data ought not to be ignored, has indicated the close and intimate relationship between such phenomena as forgetting, moods, character, likes and dislikes, ambitions, mental and physical ability, habits, the development of special aptitudes,—and the complex. The analyses of insane persons and criminals on the one hand, and those of geniuses, artists, poets, on the other, have shown that the type of complex in both groups is very much alike. These dynamic units, by the way, find their counterpart in the engrams of Semon's mneme, but it does not necessarily follow from that, that all complexes are inherited; some are, a large number are not.

INSTINCT AND REASON

In this connection, it might be well to mention that instinct, for example, is merely a mass of inherited complexes, and in terms of the mnemic theory, merely a group of engrams. The effect of one impulse acts as a stimulus to the second, the effect of the second acts as a stimulus to the third, and so on until the chain of action is complete. It is Hall (15) who indicates the superiority of instinct over reason, and his statement is of significance for us, since we are so liable to overemphasize the importance of conscious, superficial, intellectual factors over those which are unconscious, innate and organic. "The superiority of instinct over reason is that it regulates conduct in the interest of the species at every point, while consciousness is selfish and is exactly measured by the degree to which the individual has broken away from the dominance of the race and set up for himself against it" (p. 211).

The Freudian and Adlerian schools have already contributed a mass of material which is of enormous importance for the study of character and personality. One main achievement of the Zürich school has been the discovery that the principal roots of personality and character lie in the unconscious. Another valuable contribution was their proof that the early impressions of childhood were of enormous significance in the later development of the individual. Waldstein ably summarizes these two aspects in his article on the unconscious ego and

its relation to health and education (38): "What is often called heredity is merely the expression of the subconscious ego, whose origin can often be traced back to early childhood, to the time when the acts of the parents and their example left their impress in the unconscious" (p. 8, 9). Idiosyncracies of action, peculiarities, sympathies, antipathies, likes and dislikes, prejudices, preformed judgments, aggressiveness, passivity, marked artistic ability and tendencies, temperament, these and many more traits of character have been explained on the basis of acquired complexes. And as far as the evidence and explanations are concerned, they both seem quite valid. The significance of the powerful mass of "Triebe" and impulses in the unconscious must not be neglected by the careful student of heredity.

THE WORK OF ADLER

Disagreeing with Freud in certain essential details, Adler broke away entirely and, aided by his followers, continued his studies on normal and neurotic children. In its essentials his "minderwertigkeit" theory, to explain certain motives of conduct, is as follows: None of us is born with a system all of whose organs are perfect in structure or function. There is a weak spot somewhere. This will be manifested very early in life in defective reactions to the environment. An attempt, conscious or unconscious, will then be made to compensate for that defect, either by a symmetrical organ undertaking the extra labor; or by an entirely different organ adapting itself to care for the extra burden, the defective organ in both cases becoming hypertrophied; or, finally, by a hyperfunctioning of the inferior organ. This compensation activity may also be manifest in cases where organ-defect is not necessarily the basis. For example, a child lies about the occupation of its father, saying that he drives the king's carriage, when in reality he is a coal dispenser in very poor circumstances. The defect here is, of course, one of social position, and the extra activity of the imagination is induced to compensate for this defect. There is hardly time to go into his explanation of the "manly protest" and the "Aggressionstriebe," but on the basis of these compensating factors, Adler explains musical and artistic ability, the development of great orators and singers, miserliness, humility, the tendency to enter some particular profession, etc.

I regret being unable to make more than mere mention of the work of Swoboda and Fliess on the effect of periodicity in human behavior, and of the research of such men as B. Berliner, W. Schmidt, Lehmann and Pedersen, on the effect of weather conditions: changes in barometric pressures, winds, temperatures, atmospheric ionizations, solar radiations, etc., on the actions of mankind. Climatopsychology has already developed a fair-sized literature.

RESEARCH CAUSES OPTIMISM

Of course, all these fields are virgin. A great deal of further research is necessary. But as far as they have already developed, one gains much optimism from the growing belief that after all, those people who possess a peculiar trait which tends to make them more or less unsocial, *e.g.*, bad-temper, or the tendency to lie, are not necessarily doomed to suffer this defect all through their lives, to be avoided in marriage by those who make eugenics their religion, but that rather by means of a proper therapeusis, by a proper handling of the environmental, unconscious, as well as hereditary factors, these harmful expressions can be harnessed, "sublimated," and the energy driven into a different, more socially-advantageous channel.

In closing this paper I wish to bring to your attention, in view of the above-mentioned facts, a typical study of a so-called mental trait, namely musical ability. To begin with, no psychological analysis was made to determine what constituted musical ability. The conclusions as to its heritability were based upon the returns of questionnaires filled out by professional men, farmers and business men,—people hardly qualified to make an accurate judgment of the matter. Personally, I wonder what standard was used. Was a person considered possessed of musical ability if he were able to sit through a musical comedy or

a burlesque show, and on his return home whistle half the tunes over to you, or was only he regarded as being musical who could perform that feat after attending a symphony concert or a Wagnerian opera? So much for the receptive type. Or perhaps none of the receptive type was classified as musical, those only who were creative being qualified to be designated as such. Well, then, if that were the case, was he considered musically artistic who could, in half an hour or so, compose a catchy piece of "rag-time," or was it only he who after labored efforts produced a classical masterpiece? Were there among our judges any who considered Wagner's music an abomination of discord, and regarded an idolizer of that German's genius, an ignorant boor? Yet, whatever the conditions and standards, the following were the conclusions: "When both parents are exceptionally good in music (whether vocal or instrumental), all the children are medium to exceptionally good." Hurst's explanation that musical ability acts as a recessive was accepted. "When both parents are poor in musical ability and come of ancestry that lacks on one or both sides such ability the children will all be non-musical." "When one parent has high musical ability and the other has little the children will vary very much in this respect."

If we really have been as careless in our methods as it seems, ought we resent the criticism of our English confreres, or ought we not better mend our ways and be a bit more cautious in the future?

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Variation in Pure Lines

The Ohio Agricultural Experiment Station has been studying variation in pure lines of wheat since 1907, the characters under observation being size of kernel, length of head, tillering and protein content. Each year 1,000 heads of wheat and oats are selected and perpetuated as pure lines, in order to find more desirable varieties of these cereals, if any such exist. Similar work is being done with soy beans, but not on such a large scale. Hybridization of corn and tobacco is also under way.

The search for variation in a pure line has not yet been productive of any important result. C. V. Williams sends the following note:

"The fifth crop of wheat harvested in our high and low protein work gives the following results:

		Percent. protein
Fultz pure line	High protein selection	13.02
	Low protein selection	12.46
Poole pure line	High protein selection	14.10
	Low protein selection	13.52

The average protein content of the seed used for the five seasons is:

	Fultz	Poole
High protein	17.43%	17.94%
Low protein	12.01	12.02

This will have to be continued some years longer before we shall know whether this apparent variation is heritable or not. Three years of the work are reported in A. B. A., Vol. 8, p. 409."

APPLE BREEDING IN IDAHO

Needs of State Lead Experiment Station to Undertake Production of New Varieties on Large Scale—Preliminary Report on Crosses Made—Burbank's Method of Selecting Seedlings[1]

C. C. VINCENT

Agricultural Experiment Station, Moscow, Idaho

BY the Adams Act, approved March 6, 1906, funds were made available for research work along agricultural lines in the state experiment stations. This fund made it possible for a number of stations to undertake plant breeding projects. Horticulturists realized that if there was to be progress in fruit growing, new and better varieties must be developed. The discovery in 1900 of Mendel's Law establishing some elementary formulas of heredity had given impetus to this work. Hence, during the past ten years, rapid advances have been made in many states; and one of the fruits to which especial attention has been devoted is the apple.

The need of such work is apparent. Previous to this time, but very little careful apple breeding work had been done. In a recent bulletin from the Geneva Experiment Station, Professor U. P. Hedrick says: "Of the 698 varieties described in the apples of New York, both male and female parent are certainly known for only one variety; one parent is known and the other guessed, for two other kinds; four are held to be sports from known varieties; and the female, or seed producing parent is given for thirty-nine kinds. Of the 650 varieties, seventy-one are said to be seedlings (of unknown parentage); but for the great majority of the kinds, nothing is positively known as to the origin. This poor showing for scientific, commercial or careful amateur apple breeding is due to several causes: Breeding tree fruits of any kind is time-consuming and space-demanding; the pecuniary rewards for individuals are inconsiderable or altogether wanting; institutions organized to do plant breeding have felt obliged to work in other fields where results could be more quickly secured and would mean more when obtained; and lastly, plant breeding, especially breeding of tree fruits, has until recently seemed largely a matter of guess work and chance—a process most of whose fundamental laws were unknown."

Of recent years, a number of stations, especially New York (Geneva), Iowa, Minnesota, South Dakota and Idaho, have trees from hand-crossed flowers of which both parents are known. The work at the Idaho Experiment Station has progressed along definite lines. The object of the work has been the improvement of existing varieties of apples by breeding.

NEW VARIETIES NEEDED

The need of winter varieties of apples, superior to existing types, has been keenly felt by those interested in the culture of this fruit. There are many varieties already grown that have many desirable characters, but no one of them combines all of these good features.

The Jonathan, for instance, has the color and quality to make it a prized dessert apple, but its keeping quality is not the best and it is especially bothered with storage scald and "water core." It is also very susceptible to blight. Likewise, the Ben Davis has its desirable and undesirable features. It is a great producer, the apples are good keepers, the trees late in blooming, remarkably thrifty and free from disease. The fruit is thick-skinned and is not easily

[1] Read before the twelfth annual meeting of the American Genetic Association, August 5, 1915, at Berkeley, Cal.

bruised in shipping. On the other hand, the fruit lacks in crispness, juiciness, flavor and texture, required to make it greatly prized either for home or market use. A great drawback in northern latitudes to the Ben Davis is that it is so late maturing that proper coloring is not secured except in exceptional cases.

The good and bad points of many other varieties might be mentioned, but what has already been said will serve to show the need of combining the desirable qualities of different varieties so that one variety may stand preëminently in the lead. In this connection, it should be mentioned that varieties of apples display many different types. Some trees are hardier, resist disease better, have better colored fruit, are later blooming and produce fruit of much better quality than do other trees of the same variety under the same cultural conditions. Thus in our work, we have taken these factors into consideration, with a hope that these desired characters may be intensified to their maximum extent.

For this improvement, the Ben Davis variety has been taken as a basis, using it as male and female. Crosses have been made with other varieties and from the resulting hybrids those will be selected that give promise of being adapted to conditions here.

METHOD OF OPERATION

The methods of securing cross pollinated fruits are much the same as those followed by plant breeders in general. The unopened blossoms are emasculated and pollen from other varieties applied when the pistils are receptive. Usually two emasculated blossoms are left to the cluster. In the fall the pollinated apples are harvested and kept in common storage until Christmas. They are then brought to the laboratory and the seed removed.

The seeds from each cross are separated from the fruit, given a serial number and tied in muslin bags. These bags are put in 2-inch pots, placed in flats and buried where they are exposed to freezing weather. As a precaution against destruction by mice, the flats have always been covered with screen wire. Late in February the flats are brought to the greenhouse and the seed germinated. By subjecting the seed to the above conditions, we have been able to get approxiamtely 95% germination. By the middle of May, the seedlings are from 10 to 12 inches in height; they are then transplanted to the nursery, in rows 3 feet apart, trees 6 inches apart in the row. The second season, the seedling trees are transplanted to their permanent places in the orchard, 6 feet apart each way. The results obtained thus far are as follows:

1910. During the spring of 1910, a total of 1,175 crosses was made. The seed taken from the fruit of these crosses produced 146 seedling trees. The parentage of these crosses follow:

Female	Cross	Male	Number of Trees
Ben Davis	x	Jonathan	64
Ben Davis	x	Spitzenberg	55
Ben Davis	x	Ben Davis	2
Ben Davis	x	Wagener	3
Jonathan	x	Ben Davis	14
Winesap	x	Ben Davis	1
Jonathan	x	Jonathan	1
Wagener	x	Ben Davis	4
Delicious	x	Jonathan	2

1911. A total of 3,000 crosses were made in the spring of 1911. From the seed of fruits crossed this year, a total of 1,920 healthy seedlings trees were secured. The crosses made and the number of trees secured from each cross follow:

Female	Cross	Male	Number of Trees
Jonathan	x	Ben Davis	916
Wagener	x	Ben Davis	280
Ben Davis	x	Jonathan	301
Spitzenberg	x	Ben Davis	121
Ben Davis	x	Spitzenberg	62
Jonathan	x	Jonathan	1
Rome Beauty	x	Ben Davis	2
Ben Davis	x	Wagener	6

1912. Due to unfavorable climatic conditions, only 1,703 crosses were made. We were very successful in germinating the seed taken from these fruits and the results were that 3,065 seedling trees grew. The number of trees from each cross is as follows:

Female	Cross	Male	Number of Trees
Ben Davis	x	Jonathan	508
Jonathan	x	Ben Davis	1,042
Ben Davis	x	Wagener	181
Wagener	x	Ben Davis	551
Jonathan	x	Wagener	175
Wagener	x	Jonathan	485
Jonathan	x	Spitzenberg	57
Spitzenberg	x	Jonathan	66

1913. In the spring of this year, 2,823 crosses were made. One thousand four hundred and seventy healthy trees grew from these crosses. The following table shows the number of seedlings secured from each cross:

Female	Cross	Male	Number of Trees
Jonathan	x	Ben Davis	603
Jonathan	x	Wagener	500
Ben Davis	x	Jonathan	314
Ben Davis	x	Wagener	53

1914. During this year, 2,527 crosses were made. From this number 4,544 healthy seedlings were grown.

Female	Cross	Male	Number of Trees
Gravenstein	x	Newtown	22
Gravenstein	x	Jonathan	20
Spitzenberg	x	Ben Davis	153
Spitzenberg	x	Rome	28
Spitzenberg	x	Jonathan	80
Spitzenberg	x	Newtown	66
Spitzenberg	x	Wagener	238
Ben Davis	x	Spitzenberg	107
Ben Davis	x	Wagener	23
Ben Davis	x	Rome	147
Ben Davis	x	Newtown	57
Jonathan	x	Spitzenberg	542
Jonathan	x	Wagener	391
Jonathan	x	Newtown	68
Jonathan	x	Rome	42
Jonathan	x	Arkansas Black	147
Wagener	x	Spitzenberg	41
Wagener	x	Rome	818
Rome	x	Ben Davis	241
Rome	x	Spitzenberg	337
Rome	x	Wagener	326
Rome	x	Newtown	631
Arkansas Black	x	Jonathan	5
Newtown	x	Spitzenberg	8
Newtown	x	Wagener	6

Summary: To date, there are 10,915 hybrid seedlings growing in our orchard and station nursery. The total number of trees secured from each cross is as follows:

Female	Cross	Male	Number of Trees
Ben Davis	x	Jonathan	1,187
Ben Davis	x	Spitzenberg	224
Ben Davis	x	Wagener	266
Ben Davis	x	Rome	147
Ben Davis	x	Newtown	57
Ben Davis	x	Ben Davis	2
Jonathan	x	Ben Davis	2,575
Jonathan	x	Wagener	1,066
Jonathan	x	Spitzenberg	599
Jonathan	x	Jonathan	3
Jonathan	x	Arkansas Black	147
Jonathan	x	Newtown	68
Jonathan	x	Rome	42
Spitzenberg	x	Ben Davis	274
Spitzenberg	x	Rome	28
Spitzenberg	x	Newtown	66
Spitzenberg	x	Wagener	238
Spitzenberg	x	Jonathan	146
Wagener	x	Ben Davis	835
Wagener	x	Spitzenberg	41
Wagener	x	Rome	818
Wagener	x	Jonathan	485
Rome	x	Ben Davis	243
Rome	x	Spitzenberg	337
Rome	x	Wagener	326
Rome	x	Newtown	631
Arkansas Black	x	Jonathan	5
Newtown	x	Spitzenberg	8
Newtown	x	Wagener	6
Gravenstein	x	Newtown	22
Gravenstein	x	Jonathan	20
Delicious	x	Jonathan	2
Winesap	x	Ben Davis	1

This material will give us a splendid opportunity to study fundamental principles, useful in plant breeding. We are trying to find correlations and are working along the lines recommended by Luther Burbank. In a recent communication from Mr. Burbank, he says: "In selecting apple seedlings, my practice has been first of all to select those which do not mildew—this can be easily done while they are young. This eliminates one of the worst qualities in apple seedlings. Next, I thin out all the very slender growers with small deeply cut leaves. These always tend back to the wild state. In the next selection, I give preference always to those having large fat round buds, large thick leaves and a stocky growth."

Such a procedure will enable the plant breeder to discard undesirable seedlings without having to grow each plant through to maturity in order to determine its characters.

DOUBLE SEEDING PETUNIAS

Crossing and Selection Result in Production from Single and Imperfect Double Types of Four Strains That Are Double and Produce Seed—Methods of Operation—Curious Variations Observed[1]

MRS. MYRTLE SHEPHERD FRANCIS, *Ventura, Cal.*

BEFORE presenting the subject of my double petunia that reproduces itself, I want to state that I claim no scientific attainments, that while the scientific aspect of the work has been of deep interest to me my chief aim has been to produce the finest strains of double petunias to be had in the market and to make those strains reproduce themselves. Competent authority assures me that my work has been successful.

Data regarding the crossing of both single and double petunias is exceedingly difficult to obtain as most of it is scattered about in horticultural reports and magazines.

The first single petunia was found by Commerson in Argentina, on the banks of La Plata River, and sent by him to Jussieu, who named it *Petunia nyctaginaflora*, introducing it into France in 1823. This plant had an upright habit with thick sticky leaves and long-tubed fragrant white flowers. The second species was sent by Tweedie from Buenos Ayres to the Glasgow Botanical Gardens in 1831. This plant had a decumbent habit, small violet purple flowers and short tube and was named *Petunia violacea*. From these two species all varieties of petunias have been bred. They have been freely crossed with each other; hence the garden varieties now go under the general name of *Petunia hybrida* Hort.

While the nyctaginaflora type is quite common, the true violacea form is seldom seen, proving that the nyctaginflora species was the dominant factor in the early crosses. Even today most varieties revert to that form when left to themselves.

For convenience sake I shall loosely divide the single varieties now under various names into two classes: those with upright habit, long-tubed flowers with small reproductive organs, slender style and filament adherent low down in the corolla tube and wide range of colors with satiny texture, as hybridas, representing *P. nyctaginaflora;* and the varieties with the decumbent habit, large leaves, flowers with short tube, large reproductive organs, thick style and filament adherent high up in the corolla tube and limited range of colors, as representing *P. violacea.*

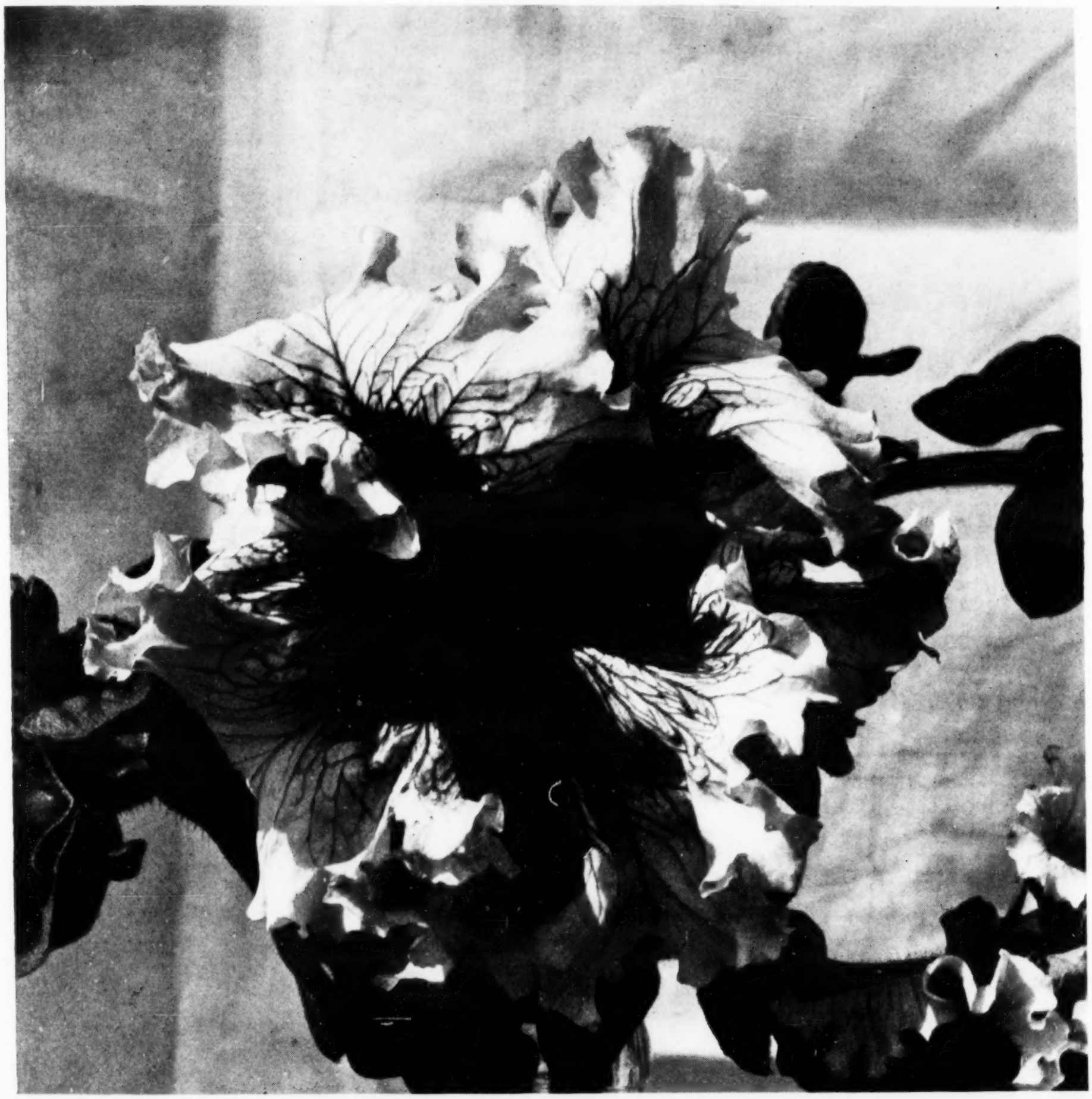
The first double petunia appeared in a private garden in France in 1855 and from this, so far as I have been able to learn, have all other doubles been obtained by artificial fecundation.

METHOD OF OPERATION

For the benefit of those in this audience who may be unfamiliar with the method by which double petunias are obtained I will explain, that the double is an imperfect flower and the single is a perfect flower. The unbroken anthers (the pollen-bearing organs) of a single flower are removed, the flower is then covered with gauze or paper until the stigma is ready, the pollen is then applied from a double flower by means of a camel's hair brush and the covering replaced, to prevent the possibility of insect fertilization.

Such a procedure, however, is entirely too laborious for commercial work. I have never used the coverings but remove the anthers and pollenize at once from a nearby flower, double and single plants being grown in adjoining plots.

[1] Read before the twelfth annual meeting of the American Genetic Association, at Berkeley, California, August 6, 1915.



FEMALE PARENT OF THE CROSS

Petunia grandiflora, shown above, natural size, is single and has perfect reproductive organs, producing several hundred seeds from each flower. So far as she can learn it had not been used in commercial production of double-flowering petunias until Mrs. Francis began to work with it, all breeding have previously been done with various forms of *Petunia hybrida*. (Fig. 6.)

From the size of anthers and stigma, colors and habit of growth it would seem that the hybrida had been universally used for both male and female parents, until recent years.

Though advised otherwise, in my early work I chose the form known as grandiflora as the female parent for my doubles, probably because the flowers were easier to work with. Later when an ideal had formed itself in my mind the grandiflora seemed more likely to give the desired results.

Many doubles have rudimentary organs of reproduction, but in my first work in 1901 I noticed this and formed the habit of examining each bloom carefully before picking it to pollenize with.

The first perfect double bloom was found on a hybrida plant in 1910. This plant had delicately fluted flowers with cream colored pollen and, when pollenized with another flower from the same plant, matured a capsule of seed. The stamens of this flower were many, rising directly through the center, the filaments being bound together by a band or collar, while the ovary sat upon a torus. The ovary of the single form sits directly upon the calyx.

From this capsule of seed thirty-seven plants were raised. No records were kept until 1911, but as near as I can remember about 75% were double, both single and double being of the hybrida type. None of these plants gave many perfect flowers though all were examined for reproductive organs and some seven or eight matured seed.

That season among our regular doubles appeared a semi-double of steel blue and white which bore all perfect flowers, and on an inferior double red was found a capsule of seed which had matured without hand pollenizing.

From these three distinct types 660 plants resulted in 1912, 85% double and 22% seeding slightly.

GREAT VARIABILITY

The petunia is perhaps the most variable flower under cultivation but its fluctuations have a certain regularity. In this generation, the three types being planted together, the wildest confusion prevailed. In it appeared for the first time the true grandiflora, represented by three plants of deep magenta color with steel-blue pollen. Their doubling was of an entirely different nature,—all extra petals were adherent to the corolla tube instead of the usual mass of petals and stamens which generally fill the center of the flowers. Nearly all blooms on these plants were perfect, though they did not all mature seed.

In this planting were also some very small inferior doubles of dingy purple flowers, which were perfect with the same manner of doubling and which matured several capsules of seed without pollenizing. Both extremes have the same form and both are fertile.

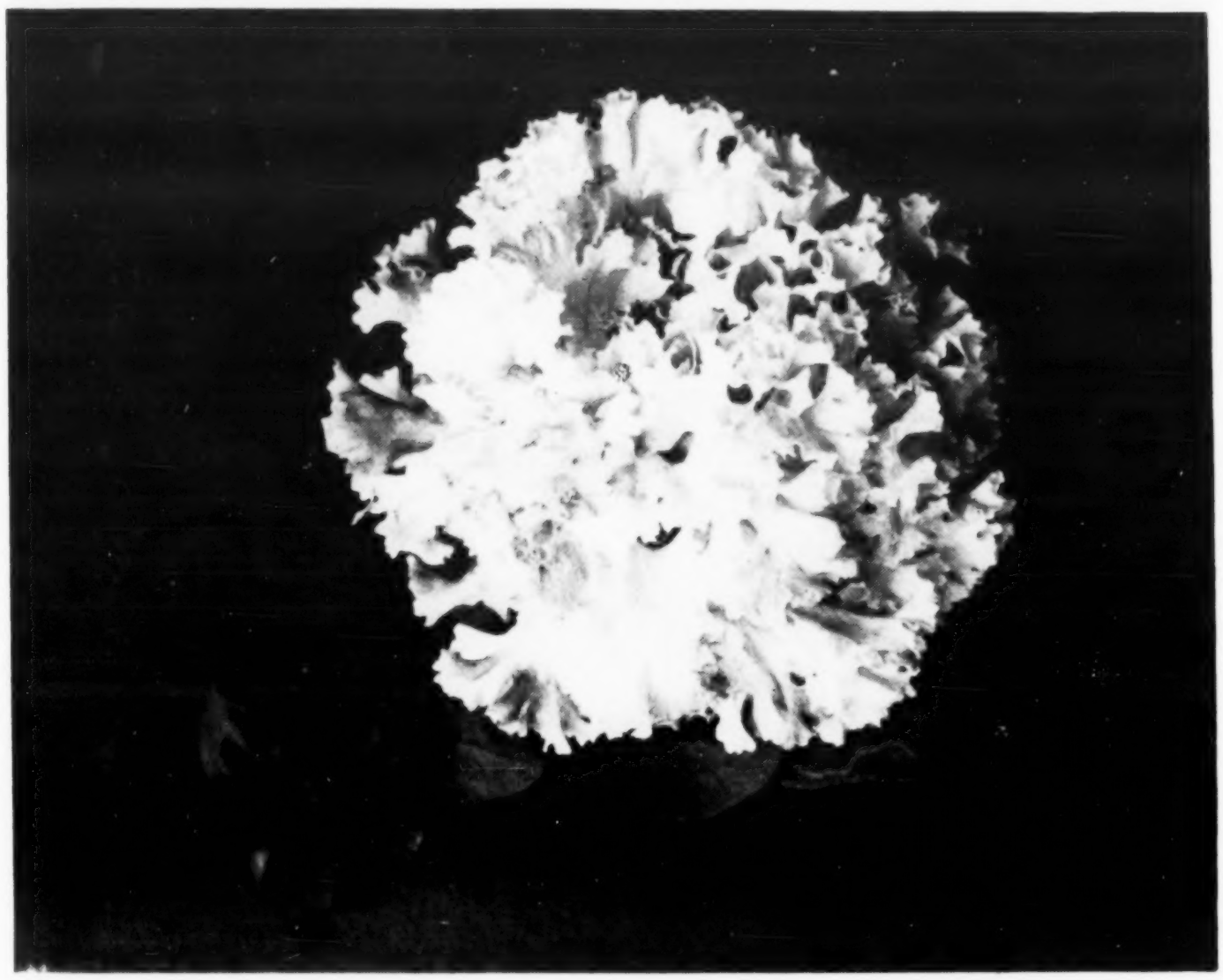
From the grandiflora crossed by the hybrida double and some seed of the hybridas also we raised in 1912, 510 plants, 73% in double, 25% seeding. Many of the flowers showed great variety of color, beauty and size.

In 1913 we got 187 plants with 73% double but 33% seeding. This year marked a decided change, the grandiflora heretofore recessive became the dominant type with blooms of extraordinary size, while its seeding capacity had increased 8%. Both beauty and reproductiveness had developed to such an extent that for our stock seed I crossed a perfect double with a perfect double for the first time, but disaster overtook me for our seed beds with our entire stock of seedlings were washed out by the floods of 1914.

Replanting from our selling stock yielded 918 plants, 85% double, 42% seeding. 1915 produced 567 plants, 90% double, 40% seeding. While the increase of doubles has been quite steady the seeding precentage has not increased so rapidly due to the use of a plant that carried singleness in its pollen but with other qualities which I wished to preserve.

I have not yet made the reciprocal cross again but expect to do so this season, as many of the fine large flowers are perfect, seeding as freely as singles when pollenized.

Doubtless my work would have been done on entirely different lines had my



DOUBLE FORM OF HYBRID PETUNIA

This was used as male parent in Mrs. Francis' crosses. The first double petunia appeared in 1855, and since then they have been steadily produced, but as the doubles produced pollen but could not set seed, it was necessary to create them by a new cross each year, since they could not reproduce themselves. Doubles had to be crossed on singles, the latter then bearing seed which produced a small proportion of double flowers. Mrs. Francis undertook to produce a strain of doubles that would not have to be crossed on singles this way each year, but would be capable of bearing seed. For this purpose she crossed the above hybrid form with the giant-flowering form shown in Figure 6. The result has been successful: not all the double flowers produce seeds, but enough of them do to make the culture commercially profitable. (Fig. 7.)

knowledge been greater in the beginning. During the last five years I have bred four distinct strains of double seeding petunias, steadily increasing doubleness, lengthing the stems, and giving greater delicacy to the texture and colors. In all my work those qualities have had precedence over reproductiveness.

Many interesting and curious variations have been observed, in one of which the whole flower becomes petalous. Some of the finest flowers are pistillate, reversing the old form, others have anthers containing no pollen, while some almost single blooms have malformed reproductive organs, still others are perfect but infertile, etc.

Lavender and steel blue seem to be the best seed producers and I am quite sure that blue pollen is more productive of fertility in doubles than yellow, which continues to give about 25% seeding plants. This may be due to the contracted throat which seems to accompany this pollen.

Of volunteers which appear each season the doubles predominate. I have never found one with other than blue pollen.

The small pointed capsule of the hybrida containing about 250 seeds has developed with the flower, one capsule often producing as many as 450 seeds. The dehiscence in singles is in twos but in these doubles it is often in threes and fours.

In conclusion I quote from De Vries *Species and Varieties:* "Hays has repeatedly insisted upon the principle of the choice of the most favorable variety

ONE RESULT OF FIVE YEARS OF BREEDING

By crossing the two forms shown in the preceding photographs, one single and producing seed, the other double and producing no seed, Mrs. Francis was able to get forms like this, which are not only double but produce seed as well. They are, therefore, a great improvement over the previously known double forms, from the gardener's point of view. In spite of this, reproductivity has been only a secondary object of the breeding, most attention having been given to improving the shape and color along lines that would be likely to appeal to the lover of this very variable member of the potato family. (Fig. 8.)

for the experiments in improving races. He asserts that half the battle is won in choosing the variety which is to serve as a foundation stock, while the other half depends upon the selection of parent plants within that variety." I blindly striving to realize my ideal unconsciously chose the most favorable variety and the right parents in that variety for what I desired to produce, and if the entire stock of these strains should be lost, with my present knowledge I could consciously choose the right variety and the right seed parents in that variety and other strains of seed producing double petunias could be developed.

Heredity in the Soy Bean

Inheritance of chemical characters of the soy bean is under investigation at the Wisconsin Agricultural Experiment Station, while the experiment is also being used to bring to light the mode of inheritance of morphological characters. A similar investigation relates to Datura, the primary object of which is to learn how the alkaloidal content of the plants is influenced by heredity. The usual practical lines of breeding of old or new varieties are also carried on.

Hybrid Histology

Histological study of hybrids, a subject too much neglected by genetists, is reported from the Mississippi Agricultural Experiment Station, particularly with reference to interspecific crosses of tobacco, and a cross between the radish and kohlrabi. A study of the cells of hybrids shows that in many cases the supposed dominance visible in external characters is more or less of an illusion. Of 121 characters of hybrid plants studied in this investigation, it was found that 100 were intermediate between those of the two parents. "A hybrid character that appears to show pure dominance may upon close examination be found to be intermediate if its structural basis be examined." This was one of the early discoveries of the pioneer genetists who submitted Mendel's laws to such critical tests, following their rediscovery in 1900; but since then most plant breeders have followed the evidence of the unaided eye, and failed to look below the surface when pronouncing on the dominance or lack of dominance of any character. "The xylem of the root of the radish by kohlrabi hybrid illustrates this; the central part of this root when examined *macro*scopically appears to be dense wood, as dense as the wood of the central part of the root of the kohlrabi parent, but if this xylem is examined *micro*scopically it is found to have a considerably larger per cent. of thin-walled, unlignified cells, thus presenting a structure intermediate between the two parents." It may be added that this work, reported in Technical Bulletin No. 3 of the Mississippi station, was actually performed in the laboratories of Cornell University by Harry B. Brown.

More Profit from Grains

Tests of wheat and oat varieties are an important part of the Indiana Agricultural Experiment Station's work. The latter study has been carried on for ten years, and the average yield of the ten highest varieties has been computed as 12.3 bushels more per acre than the average of the ten lowest varieties. This difference, as the station is busy pointing out to the farmers, is sufficient to pay for nearly one-half the cost of producing the crop.

ORIENTAL IMMIGRATION

Problem of Immigration on Pacific Coast of Much Less Importance to Eugenics Than That on Atlantic Coast, Because Intermarriage is Rare—How the Immigration Laws Work[1]

W. C. Billings

Surgeon, U. S. Public Health Service; Chief Medical Officer, Immigration Service, Angel Island (San Francisco), Cal.

FROM the viewpoint of eugenics alone the administration of the immigration law (including the Chinese Exclusion Law) is not so important, because not so far reaching, on the Pacific coast as the execution of the same laws at ports situated upon our eastern boundary. It may be of as great, or possibly even greater, importance upon the Pacific coast if viewed from other standpoints,—for instance that of economics, standards of living, and possibly, in the opinion of a considerable number of people, that of simple fairness. The reason for the lesser degree of living interest, in so far as the application of the laws mentioned bear upon the subject of eugenics, is simple, and is tersely put by the man who has the ability, in such a pre-eminent degree, of sensing the feelings and attitudes of all sorts of peoples, when he says "and never the twain shall meet."

The application of this expression to the problem of eugenics and the administration of the Immigration Law upon our west coast, which really amounts to saying the problem of eugenics in its relation to the citizens of our country and the Oriental, is not in the slightest degree a reflection upon the peoples of any of the countries concerned,—it is simply an expression used in an explanatory way to accent the point that, as a purely eugenic consideration, the execution of the immigration law upon the Pacific coast is not of very great moment for the very simple reason that, upon both sides, there seems to be, speaking broadly, absolutely no disposition to inter-marry.

In the opinion of the Rev. B. C. Howorth, who spent nineteen years in Japan as a missionary, and who for the last eight years has been employed by the United States Immigration Service as Japanese interpreter, there are on our whole Pacific coast not more than twenty instances of intermarriage between Americans and Japanese, and in the opinion of John Endicott Gardiner, for sixteen years resident in China and for thirty years Chinese Inspector in the United States Immigration Service, one might count on the fingers of both hands the number of American-Chinese marriages between San Diego and Seattle. Both of these men are in close touch, respectively, with Japanese and Chinese matters and conditions and are able to give an approximately accurate estimate of the extent of intermarriage.

CONTRAST ON TWO COASTS

The immigration received at our Atlantic ports, while certainly racially heterogeneous enough to satisfy the most extreme longing for variety, still admits, and as time goes on will admit more and more, of an opportunity to study from a eugenic standpoint the ultimate product of the "melting pot." The explanation of this opportunity is as simple as is the explanation for the lack of opportunity previously spoken of,—it is simply that, given propinquity, Occidental races will intermarry to almost any extent, but under such

[1] Read before the twelfth annual meeting of the American Genetic Association, August 3, 1915, at Berkeley, California.

conditions as have so far existed in the United States the Occidental exhibits no tendency to intermarry with the Oriental and that lack of inclination seems to be entirely mutual.

The administration of the immigration laws at California ports is supposedly the same as at all ports of entry located wherever they may be, with the addition of the Chinese exclusion law. Naturally the last named law applies at certain other places, but it is at those ports situated upon the Pacific coast that the opportunity, or necessity, for its greater scope exists.

The expression "ports of entry" used in an immigration sense must not necessarily be connected in one's mind with seaboard cities alone,—it means any place where the Immigration Service has its officers regularly located, and may be a thousand miles from the coast. There are, for instance, sixty-five places stretched along the Canadian border through any of which aliens may lawfully enter the United States provided they present clearly their eligibility to do so, and twenty-five of these places have what are called "boards of special inquiry" for the consideration of those cases in which the right to land, under the immigration laws, is not clearly established. On the Mexican border thirteen ports of entry are located.

All ports of entry consider the application for entry to our country of all aliens, from any country whatever, with the one exception of Chinese, while certain cities are designated as Chinese ports of entry and any Chinese not entering through one of them is surreptitiously in the United States; these places are San Francisco and San Diego, Cal.; Portland, Ore.; Boston, Mass.; New York, N. Y.; New Orleans, La.; Port Townsend and Seattle, Wash.; Tampa, Fla.; Honolulu, Hawaii and San Juan and Ponce, P. R.

In considering the administration of the Immigration Laws at California ports we have then to consider San Francisco, San Diego, Andrane, Campo, Calexico and Tia Juana, and to bear in mind that while there are two laws, one called the Immigration Law and the other the Chinese Exclusion Law, they both, from any but an official standpoint, are alike in their aim and result, namely, the keeping of undesirable aliens out of the United States.

The immigration to California ports is, broadly speaking, entirely Oriental, consisting of Japanese, Chinese, Koreans and Hindus, the number of arriving aliens of Occidental lineage being so small that for the purposes of this paper they may be disregarded.

All aliens, including of course Orientals, have to comply with the general requirements of the immigration laws, but in a certain sense the arrivals at California ports have to go somewhat farther in that the Chinese have to meet the restrictions of the Chinese Exclusion Law, while our Government has an agreement with the Japanese governmet regarding a certain type of Japanese immigrant.

EVOLUTION OF THE LAWS

The immigration laws of our country have evolved gradually and changes have been made from time to time in order that they may meet conditions not existing, or not realized, at the time of their framing. To the organic laws must be added such interpretations and constructions of them as have been made by various departmental officials and the resulting total presents at times a rather difficult and intricate executive problem, especially if it be borne in mind that the humanitarian aspect is a factor that cannot, and should not, be overlooked, because in the application of these laws we are not deciding something concerning inanimate chattels but are dealing with human beings who have done no wrong and whose hopes and fears and aspirations are the same as ours.

The first immigration act was approved March 3, 1875, and the last March 4, 1913. Between the two there have been eighteen acts amending, either by elimination or addition, some portion of acts previously passed. The law as it stands today consists, we may say for the sake of clearness, of two portions—namely, the portion bearing

directly upon the moral, social and financial condition of the alien and his past history in regard to these conditions, or in other words, to coin an expression, his "immigration status;" and the medical portion, which concerns itself entirely with the mental and physical condition of the immigrant.

Quoting from Section 2 of the Act of February 20, 1907, as amended by the Acts of March 26, 1910, and March 4, 1913, "the following classes of aliens shall be excluded from admission into the United States: . . . Paupers; persons likely to become a public charge; professional beggars, . . . persons who have been convicted of or admit having committed a felony or other crime or misdemeanor involving moral turpitude; polygamists, or persons who admit their belief in the practice of polygamy; anarchists, or persons who believe in or advocate the overthrow by force or violence of the Government of the United States, or of all government, or of all forms of law, or the assassination of public officials; prostitutes, or women or girls coming into the United States for the purpose of prostitution or for any other immoral purpose; persons who are supported by, or receive in whole or in part the proceeds of prostitution; persons who procure or attempt to bring in prostitutes or women or girls for the purpose of prostitution or for any other immoral purpose; persons hereinafter called contract laborers who have been induced or solicited to migrate to this country by offers or promises of employment or in consequence of agreements, oral, written or printed, expressed or implied, to perform labor in this country of any kind, skilled or unskilled; those who have been, within one year from the date of application for admission to the United States, deported as having been induced or solicited to migrate as above described; any person whose ticket or passage is paid for with the money of another, or who is assisted by others to come, unless it is affirmatively and satisfactorily shown that such person does not belong to one of the foregoing excluded classes and that said ticket or passage was not paid for by any corporation, association, society, municipality, or foreign government, either directly or indirectly; all children under 16 years of age unaccompanied by one or both of their parents, at the discretion of the Secretary of Labor or under such regulations as he may from time to time prescribe: Provided, That nothing in this Act shall exclude, if otherwise admissible, persons convicted of an offense purely political, not involving moral turpitude: Provided further, That the provisions of this section relating to the payments for tickets or passage by any corporation, association, society, municipality, or foreign government shall not apply to the tickets or passage of aliens in immediate and continuous transit through the United States to foreign contiguous territory; and provided further, That skilled labor may be imported if labor of like kind unemployed cannot be found in the country: And provided further, That the provisions of this law applicable to contract labor shall not be held to exclude professional actors, artists, lecturers, singers, ministers of any religious denomination, professors for colleges or seminaries, persons belonging to any recognized learned profession, or persons employed strictly as personal or domestic servants."

It will be seen that the portion of the law which has just been quoted relates to what I have called the "immigration status" of the alien. The medical portion of the same paragraph of the law reads as follows, "The following classes of aliens shall be excluded from admission into the United States: All idiots, imbeciles, feeble-minded persons, epileptics, insane persons, and persons who have been insane within five years previously, persons who have had two or more attacks of insanity at any time previously; persons likely to become a public charge, persons afflicted with tuberculosis or with a loathsome or dangerous contagious disease; persons not comprehended within any of the foregoing excluded classes who are found to be and are certified by the examining surgeon as being mentally or physically defective, such mental or physical defect being of a nature which may affect the ability of such alien to earn a living . . . "

In the general application of these provisions of the law at San Francisco, at which port over 90% of the work of California ports is done, the arriving aliens are examined as to what I have called their immigration status by Inspectors of the Immigration Service, who are appointed to that position after civil service examination, and physically by Medical Officers of the United States Public Health Service who are assigned to temporary duty as medical advisers to the Commissioner of Immigration.

These men board all incoming passenger ships from foreign ports immediately after the vessel is given pratique by the quarantine officer and while the immigration officers are busy determining whether or not there are any persons among the passengers who are exempt from immigration examination, such as United States citizens,

foreign government officials and their suites, and in selecting such persons as unquestionably conform to all the requirements of the law, so that they may release such persons immediately from the ship, the medical officers are closely scrutinizing the first cabin passengers with a view to determining whether or not they present symptoms of any of the diseases which are mandatorily excludable. If no such symptoms are observed, and the immigration officers have found nothing undesirable or questionable, permission to land directly from the ship is given. The medical officers then conduct an examination of the crew to determine whether or not any of them present symptoms of a loathsome or dangerous contagious disease. In the event that they do they are not allowed to land while in port and are taken back to the country from whence they came on the return voyage of the vessel. At the present time all second cabin and steerage alien passengers from all ports in the orient are taken from the ship to the immigration station on Angel Island, where a much more thorough physical examination is made than is possible on shipboard.

VOLUME OF IMMIGRATION

Fiscal year ending	Males	Females	Total	Photo brides
1905	598	209	807	133
1906	594	218	812	121
1907	1,063	329	1,392	238
1908	432	188	620	112
1909	267	222	489	146
1910	376	348	724	266
1911	842	1,028	1,870	845
1912	1,165	1,436	2,601	1,230
1913	1,863	1,529	3,392	1,317
1914	2,018	1,856	3,874	1,595
Grand totals	9,218	7,363	16,581	6,003

Because our Government of Japan have an agreement whereby Japan will not issue passports to laborers, and if a Japanese arrives without a passport the burden of proof that he is not a laborer rests upon him, and we have the Chinese Exclusion Law, it very naturally seems to many people not familiar with the conditions that Oriental immigration would not be in sufficient numbers to be of much interest. Such, however, is not an actuality as there are so many exceptions.

All Japanese, except laborers, may come to the United States, and the result in numbers arriving at the port of San Francisco alone, for the last ten years is shown in the preceding table. During the corresponding ten years the total number of aliens of all nationalities admitted at San Francisco was 76,240.

The column headed "photograph brides" represents one of the most interesting classes of Japanese immigration although the term is, strictly speaking, a misnomer inasmuch as a photograph although, very naturally, often exchanged, is in no way a necessary or indispensable part of the arrangement. The term "proxy brides" which is frequently applied to the same class is, in so far as it implies the presence of a third party, also a misnomer, as, properly speaking, there are no proxy marriages in Japan.

The agreement referred to between the American and Japanese Governments to stop the emigration of laborers was made in 1908 and at that time a very considerable number of Japanese laborers were domiciled in this country, particularly upon the Pacific coast. Section 37 of the law already quoted allows domiciled aliens to bring their wives to join them and these men very naturally take advantage of the privilege. Marriage in Japan is arranged by the parents of the contracting parties and consists of removing from the register of her own family the name of the bride and adding it, in the official register of the administrative district in which he lives, to the names of the family of the groom. There is no civil or religious ceremony unless the contracting parties happen to be Christians. The ceremony of removing the name is followed by a social gathering of friends and assumes a congratuatory character.

This custom, which constitutes the legal marriage of Japan, can be followed even through the contracting parties are not both present and the woman

becomes the legal wife of the man, leaves Japan with her passport made out as Mrs., and arrives here the wife of a domiciled alien. Six thousand and three have so arrived at San Francisco in the last ten years.

CHINESE ADMITTED

The word "exclusion" used in connection with the Chinese law doubtless leads many people into the belief that *now* there are no Chinese admitted to the United States for the first time. Such is not the case, as the following are exempt classes under the Chinese Exclusion Act, coming to the United States for the first time on passports or other means of identification:

1. Officials (including Presidents of any of the "Six Companies," made ex-officio members of the Consulate in order to be admitted.) Wives, children (natural or adopted) and servants of officials, born in any foreign country whatsoever. There are no restrictions on the official class other than the passport requirement.

2. Merchants, their wives and their children, whether natural or adopted. (Merchants may return to the United States without a new passport after spending a year in the United States as merchants on testimony of two credible witnesses other than Chinese.)

3. Travelers and their families. (After completing their travels they may remain in the United States by becoming merchants or teachers.)

4. Teachers and their families. Teachers may return to the United States on same conditions as merchants.

5. Students. These may return to the United States on the same conditions as merchants or teachers.

6. While no Chinese laborers have been allowed to come to the United States for the first time since November, 1882, nevertheless those who were in this country on that date, or who had been here and came back within ninety days of that date, were allowed to go to China and return at will up to the time of passage of the Geary Act in 1893, and since then have been allowed to go and return provided they fulfilled the requirements of registration according to law, had property worth $1,000 in the United States, or debts owed to them aggregating that amount, or had a family, and provided they returned within one year, generally speaking, or within two years if circumstances entirely beyond their control had arisen and thereby legitimately detained them.

It will be readily appreciated that with these six classes of Chinese allowed to enter the United States, the total annual Chinese immigration is of considerable volume.

Chinese immigration to this country began in 1848 when the brig "Eagle" brought two men and one woman from Hongkong—it increased rapidly but irregularly; and in a speech delivered before the United States Senate on March 7, 1878, the Hon. A. A. Sargeant estimated that, up to October, 1876, 233,136 Chinese had come to the United States and that 93,273 had departed therefrom, leaving a total of 139,863 in the country on that date.

The restrictions of the exclusion law, the departure for China and other places and the natural mortality have very greatly reduced the number of domiciled Chinese until at the present date there are probably not more than 100,000 in our country.

The exclusion law does not exclude with such inflexibility that at the present time there is no Chinese immigration as a glance at the following table showing the arrivals for the last ten years will prove.

CHINESE, including alleged citizens, landed at San Francisco alone, during the years specified. (Fiscal year ending June 30, 1915.)

Year	Male	Female	Total
1905	1,701	67	1,768
1906	1,741	102	1,843
1907	2,047	99	2,146
1908	2,889	165	3,054
1909	4,294	278	4,572
1910	3,700	252	3,952
1911	2,787	189	2,976
1912	3,130	172	3,302
1913	3,145	239	3,384
1914	3,404	206	3,610
1915	3,694	242	3,936
	32,532	2,011	34,543
JAPANESE:			
1915	2,788	2,113	4,901

It was previously stated that second and third cabin aliens from Oriental ports were brought from the ships upon which they arrive to Angel Island where in conjunction with the immigration examination, the medical examination is proceeded with. The aliens are taken to the hospital and, the sexes being separated, lined up under charge of a male or female nurse as the case may be and the eyelids of every one turned by the Medical Officer conducting the examination and the conjunctiva thoroughly inspected to determine the possible presence of trachoma, which is one of the mandatorily excludable diseases. In the case of the women the medical officer makes, coupled with the eye examination, a minute inspection of the face, hands and general appearance. The slightest suspicion of any untoward condition, such as a lung or heart involvement, a skin eruption, evidence of temperature, etc., etc., is followed by a sufficiently extensive examination appropriate to the condition to determine the diagnosis; but in the absence of any suspicious signs this concludes the physical examination. The men are all stripped to the waist, the eyelids are turned and the heart and lungs tested; at the same time notice is being taken of any skin eruption, scars, deformities, or any departure from the normal, including pronounced poor physique. If any of these conditions are observed the alien is held in the hospital a sufficient length of time to obtain a proper clinical history and to arrive at some conclusion as to the underlying cause of the condition. At the conclusion of these procedures each man is taken individually behind a ward screen and completely stripped, in order that any existing abnormality below the waist may be observed. During these examinations the possible presence of tropical disease of any kind is particularly borne in mind, and it is at this time that we detect such of those tropical conditions as obtain and which do not require the use of the microscope to establish a diagnosis, or hold for later laboratory investigation persons presenting symptoms of any disease in which the specific organism is known, this latter step being necessitated because officially the attitude is assumed that it is unjustifiable to certify as present a disease of specific origin until the specific organism has been isolated. These examinations having been completed and all conditions necessitating certification to the immigration officials having been noted, each alien, both male and female, is required to furnish a specimen of feces for hookworm examination. When these specimens are properly prepared they are sent to the laboratory for microscopical examination.

By pursuing the system outlined the medical officers have, during the last three years, detected and certified to the Commissioner of Immigration over 100 different diseases, certain ones running into numbers of considerable degree, as for instance approximately 3,000 cases of hookworm disease detected and cured before being allowed to land. The list includes, besides the conditions that we in this country are accustomed to meet, such diseases as beri-beri, morphinism, uncinariasis, smallpox, trachoma, clonorchiosis, balantidic dysentery, liver abscess, sprue, elephantiasis, leprosy and tropical dysentery.

It may be possible with the progress of time and the accompanying extension of travel with its broadening effect, and the probable partial obliteration of strict geographical lines, that intermarriage between Oriental and Occidental will be very much more frequent than at present. If that be the case it is reassuring to know that aliens arriving at our California ports suffering from mental, moral, or physical defects, or loathsome or dangerous contagious disease will, through the operation of the Immigration Law, and in so far as they come within that law, be denied admission to our country.

PLANT BREEDING PROBLEMS

Many Opportunities on Pacific Coast—New Varieties with Definite Characters Needed—Fundamental Work with Old Varieties Must Be Done —What Has Already Been Accomplished[1]

C. L. LEWIS

Chief, Division of Horticulture, Oregon Agricultural College, Corvallis, Ore.

THE Pacific coast has become world-famous because of the excellence of its fruits and fruit products. Most varieties and types of fruits that have been tried on this coast have succeeded remarkably. In fact, in most cases they do better here than they do in their native homes, growing to unusual size, developing a high degree of color, and attaining superior quality.

Now, while this fact of the success of deciduous fruits on the Pacific coast is a source of pride and satisfaction, as well of material profit, to us, I believe that it is, on the other hand, likely to lead us to the comfortable but dangerous assumption that our fruits are good enough; that, having apples, pears, plums, etc., which meet every market requirement, we have lost sight to a very large extent of the great contributions which we might make to the field of horticulture by producing new and still better varieties.

Not only should we be thus desirous of originating fruits of ever surpassing excellence, but we should be very eager to contribute to the knowledge of genetics, that we may be of service to our co-workers in this field. Do not understand me to imply that nothing has been done in this line on the Pacific coast. Consider the many contributions of Luther Burbank; the Loganberry of Judge Logan; the famous cherries of Lewelling (such as the Republican and the Bing); the introductions of other practical breeders (the Lambert, Centennial, Deacon, Lake, Hoskins, and Vesta cherries); or the superior strawberries of the Pacific Northwest; and many other improved fruits which I will not stop to enumerate—but the man who says that we have plenty of good enough varieties of fruits and nuts at the present time, and therefore need not try for new varieties, has failed to analyze the situation carefully.

SOME IMPORTANT NEEDS

We need a walnut, for example, that is immune to the ravages of the walnut blight. We need pears which can survive the attack of the fire blight. We need cherries that are never attacked by gummosis. We need prunes, especially in the Northwest, that mature earlier, are sweeter, and, if possible, larger. We need a red apple in the spring. While it is true that we have the Winesap, it is nevertheless a fact that the Winesap is very exacting in its requirements and is restricted to a rather limited area. We need an apple of wide adaptability, such as the Ben Davis, but having at the same time the qualities of the Esopus (Spitzenberg) or the Winesap, and this apple to be in its prime for the late winter or early spring market. We need cherries which escape the rainy season. Especially do we need a flesh-colored cherry of better shipping quality than is possessed by any variety we have at the present time. These are only a few of the suggestions that could be made for the practical plant breeder.

The men who are working in the field of genetics on the Pacific coast at the present time can be divided into two great classes. The first class may be called that of the plant-lover, or so-

[1] Read before the twelfth annual meeting of the American Genetic Association, Berkeley Cal., August 6, 1915.

called practical professional breeder. The aim of these men is to produce some new plant by chance or otherwise. Most of the fruits or horticultural products that have been obtained so far have come very largely by accident. I refer to the work of the Lewelling brothers, Hoskins, Logan, Burbank, Father Schoener, and many others who might be mentioned. I would in no way belittle the work of these pioneers in our field. They have contributed some of the world's choicest fruits. To Burbank we owe much; he has shown us the possibility of obtaining great variation in plants by change of environment, has taught us the value of working with large numbers and has demonstrated a wonderful aptitude and ability in segregating the valuable plants from the hosts of worthless.

One cannot help feeling, however, how much better it would be if, in connection with the origin of such cherries as the Lambert and Bing, something could be known in regard to their parentage, and the tendency of these parents to produce such fruit. Such facts would make a contribution to plant breeding well worth while, as we would have laid down fundamental foundation stones for future investigators to build on.

WORK OF SCIENTISTS

The second class of workers are our experiment station workers, research men, so to speak, who fall naturally into several divisions. First, there are those men who devote their time largely to testing certain theories of evolution; to working out certain laws of heredity; men who are attacking the fundamental problems of genetics, those which deal with the very principles of the science. A goodly number of such men will be found on the Pacific coast who will be willing to devote their lives to this work.

Second, there are those men who are dealing with problems of a somewhat indirect nature, but having a close relation to the fundamental problems of genetics. I mention the pollination studies, such as have been conducted at Oregon Agricultural Experiment Station. Some of these studies have already been published in four bulletins.

The work on the cherry has been of special interest to plant breeders, since it has shown that in the Northwest, at least, the possibility of using the Napoleon (Royal Ann), the Lambert, and the Bing is somewhat restricted, as they are sterile, and are also intersterile, so that wherever cherry seedlings are produced, they will not come as the result of crosses of these three varieties, but may come from the crossing of these varieties with others of perhaps not as great commercial value. Then there is a splendid work that Shamel is doing in southern California on the bud variation studies of citrus.

A third class consists of those workers who are forced to take up some problem having for its aim a definite commercial need, but coupled with foundation studies in genetics. I refer to the work that Webber has done with the citrus fruits, cotton, etc., to the work with the pear that is being done at the Southern Oregon Experiment Station where over twenty species of *Pyrus* have been collected, and where over 1,000 varieties of pears are being tested, to note first, their resistance to the fire blight, and secondly, to work out their value as parents in producing immune or resistant varieties of pears.

Other work is being done at the Oregon Agricultural Experiment Station with apples, cherries, prunes, etc., much along the same line as that which is being done with the pears, but of course with different aims.

I have mentioned more the work of the Oregon station, since I am more familiar with the work of that station, and not so familiar with the work under way at the other stations on the Pacific coast. Undoubtedly, however, they are also taking up this work very extensively.

PROGRESS HITHERTO SLOW

Our progress in the past has been very slow; perhaps we can almost say we have done little or nothing, practically no fundamental work in genetics as far as plant breeding is concerned. We have only touched the surface.

However, progress must be slow in a problem of this nature, and we must all be patient. The promise is very great for the future. We feel that we are on the doorstep of a dawning of great things. The workers in plant breeding are holding their breath, so to speak, for they realize that the time is close at hand when very definite, startling progress will undoubtedly be made.

Let us encourage our young investigators in every way that we can. Encourage those in the field of pure science. Encourage those who are working with the problems of morphology, cytology, physiology, and biochemistry, because many of these must be worked out before very definite progress can be made on other phases of our investigations. Let us continue our many pollination studies, for they are bound to contribute much to our knowledge of genetics. We must know more of the fundamental laws of genetics, and their adaptation to the plant kingdom, and their ultimate relation to our commercial progress. In a relatively short time we should know the value for breeding purposes of our leading varieties of fruits on the Pacific coast; we should trace back their pedigree as far as possible, and know the value of any one given variety as a parent for future work.

Some of the most promising commercial varieties may prove useless as parents, and some very unpromising commercial varieties may prove very valuable as parents. I have seen one illustration of this in apples, for example. Take the seedlings of the Ben Davis. We have found in our work that, no matter whether the Ben Davis was a male or a female parent, the seedlings from this variety tend to be weak, that they are lacking in vigor and vitality. Yet the Ben Davis apple is often spoken of as a tree of wonderful vitality. My observation of this variety, however, in the Pacific Northwest, would lead me to conclude that it is not one of great vitality. It becomes decrepit at an early age, and its seedlings are certainly very unpromising. On the other hand, we have a variety which is very seldom heard of, the White Winter Pearmain, for example. This variety when used as a parent produces vigor. It gives vegetative strength, and strong sturdy seedlings result whenever this variety is used as a parent. I simply cite these two cases to show that the field is large, that we have more work than all of us put together can do in many generations to come.

The field is measureless, the opportunity unlimited. Optimism should be the watchword of our young workers. Let the Pacific coast not only contribute to horticulture by growing to unexcelled excellence the well-known varieties of fruits, but let us contribute just as generously with new gifts of flower, fruit and vegetable, and at the same time do our share in contributing to the world's knowledge of genetics.

Grape Breeding

The first plant-breeding work in the horticultural department of the New York Agricultural Experiment Station (Geneva) was done with grapes. "The main problems with this fruit are as follows: Inheritance of color—a special effort is being made to find varieties which are pure for the various colors; inheritance of size and shape of bunch and berry; high quality; season of ripening; stamen type and its corrolary problem of self-sterility and inheritance of sex. A large number of European grapes, *Vitis vinifera*, are being grown in an attempt to find varieties adapted to this region and to use in crossing with our native species. The grape material now on the grounds comprises two vineyards of about 350 named native varieties, about fifty varieties of *Vitis vinifera*, some 800 crosses now in bearing, about 1,600 self seedlings of known varieties now in bearing and about 3,500 crosses still to fruit."

PROTECTING POLLINATED BLOSSOMS

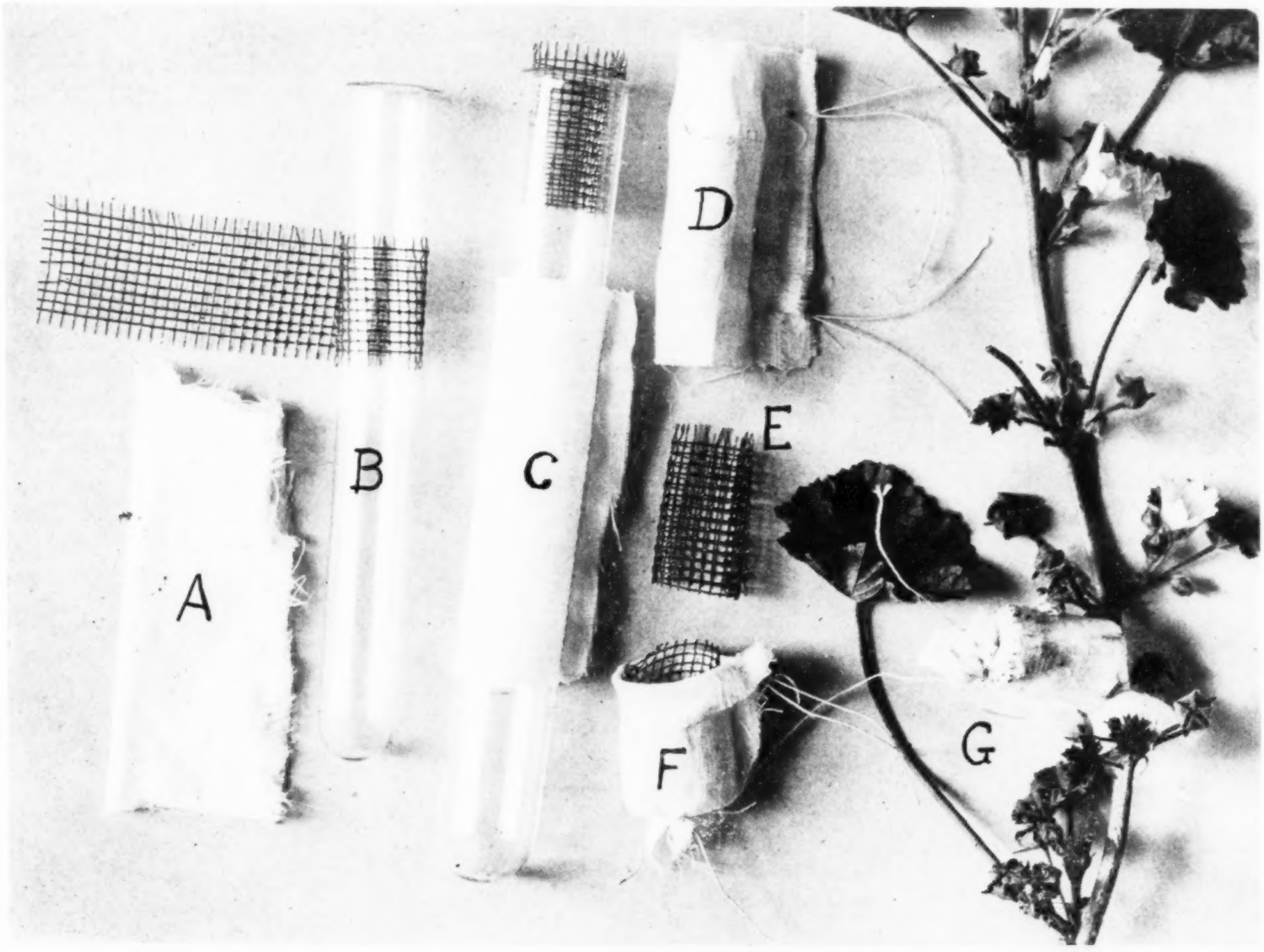
DR. WILLIAM S. CHAFIN, *Vanderbilt, Mich.*

IN cross-pollinating flowers, it is often necessary for the plant breeder to visit a blossom twice: the first time to remove the pollen from the flower, so it will have no opportunity to pollinate itself, and a second time when the stigmas are in a receptive condition, to apply the pollen from some other plant which he has selected as the male parent of the hybrid.

Between these two visits, it is of the utmost importance that foreign pollen, which might be carried by the wind or insects, be excluded—otherwise the results of the experiment will be thrown into confusion. It is also necessary, in most cases, to protect the pollinated flower for some time after the cross has been effected, for the same reason. Both these objects are usually accomplished by enclosing the flower in a cloth or paper sac, which of course must be removed when the flower is pollinated.

Removing these sacs and replacing them without injuring delicate flowers is sometimes a little difficult. A device which I have found very convenient because of the ease with which it may be opened or closed for this purpose and held in the fingers without danger of injuring the flower is seen in Fig. 9.

A strip of fine muslin of the proper width (a tag end of which is shown at A) is folded lengthwise, stitched along



CONVENIENT BAG FOR PROTECTING POLLINATED FLOWERS

It is distended by a frame of wire netting, which allows it to be put on or taken off the flower with little danger of injury to even the most delicate blossom. The use of a test-tube, as described in the text and shown at *E* above, allows the cloth to be slipped over the screen without any trouble from catching ends of the wire. (Fig. 9.)

the edges and cut into pieces long enough to fasten easily over the ends of a wire frame (E). This is formed, as seen at (B), by bending a strip of wire netting around a test tube and turning back the ends of the long wires to hold the frame together. The frame is now cut off and inserted in the muslin tube by means of a somewhat larger test tube (C). A piece of fine copper wire at each end completes the whole. (D).

To use, one end of the cloth is turned back over the frame like a cuff (F). It is then slipped over the flower and the cloth fastened about the stem with a few twists of wire as at (G). The frame may then be readily opened to inspect or pollinate the flower by simply untwisting the upper wire and turning back the cloth.

Light cardboard may be substituted for the wire netting, but is not as good in case of rain. The size of the frame should be varied, of course, to suit the case. Where the flowers are small and gathered at the end of a stem it is better to use a large sac and enclose the whole cluster.

No positive claim is made for originality as the device is one which might occur to anybody and doubtless has been used by others.

Plant Breeding in Minnesota

More than 300,000 plants a year are handled by the breeders of the Minnesota Agricultural Experiment Station, mostly with the object of increasing yield or hardiness. In alfalfa, the object is to produce better seed-bearing strains. Sugar beets are crossed with mangels to produce a good stock beet. Commercial varieties of grape have been carefully studied, some being found to be self-sterile and some self-fertile. In the self-sterile forms, the generative nucleus becomes degenerated, which prevents the further functioning of the pollen grain. This is believed to be the first time that the actual cause of self-sterility in grapes has been determined; obviously no cultural expedients can possibly overcome such a trouble, and the only remedy is the use of proper varieties. It will be recalled that the native American grapes, as a class, seem to be practically monoecious in nature. Although bearing vines produce male as well as female flowers, their female flowers are usually incapable of pollination from male flowers on the same vine, and depend on cross-pollination from vines that bear exclusively male flowers and—of course—no fruit. Such is the condition among the wild vines; but in the commercial varieties which have been created from them this habit has been modified, until in many cases a bearing vine produces good pollen for its own female flowers, and the planting of distinct male vines is unnecessary. Evidently, however, this habit is not well enough fixed to be wholly dependable, and is better fixed in some varieties than others. The scientific grape grower, then, will ascertain before planting just how the varieties he has picked out will behave when self-pollinated, and if they do not take kindly to this artificial means of fecundation, he will plant out enough male vines to insure a crop. Similar work has been done with the plum and strawberry. Statistical studies of the characters of many fruits are being made.

Why Do Apples Bloom Late?

The main breeding problem at the Virginia Agricultural Experiment Station is with apples, and the investigators are making a determined effort to find whether the late blooming attribute is a hereditary quality transmitted by definite discoverable laws. In addition there are genetic studies of color inheritance in lupins, phlox and other ornamentals, and a study of the possible inheritance of disease in the tomato.

UNIT CHARACTERS

Reality of Their Existence is Fundamental to Study of Evolution, But Has Never Been Proved—Independent Variability of Parts and Independent Transmissibility of Variations Open to Question[1]

S. J. HOLMES

Associate Professor of Zoology, University of California, Berkeley, Cal.

THE doctrine of unit characters is one that has figured largely in speculations on heredity and evolution from the time of Darwin to the present. According to this doctrine an organism is a sort of mosaic of parts each of which is dependent for its development upon some kind of discrete entity in the germ cell.

The germ cell is therefore considered a complex of organic units more or less independent of one another in their activities and transmission.

The unit character hypothesis is founded on (1) the assumed independent variability of the parts of an organism, and (2) the assumption that characters are capable of independent transmission. Independent variability was appealed to by Darwin in support of his hypothetical gemmules, by De Vries in his Intracellular Pangenesis, and especially by Weismann who has adduced a formidable array of facts in support of this doctrine upon which he founds much of his argument for the complex organization of the germ plasm.

"There are human families," says Weismann, "in which individuals occur repeatedly, and through several generations, who have a white lock of hair, in a particular spot, on an otherwise dark-haired head. This cannot be referred to external influences, it must depend on a difference in the germ, on one, too, which does not affect the whole body, not even all the hairs of the body, but only those of a particular spot on the surface of the head. It is a matter of indifference whether the white coloring of the hair-tuft is produced by an abnormal constitution of the matrix of the hair, or by other histological elements of the skin, as of the blood-vessels or nerves. It can only depend ultimately on a divergently constituted part of the germplasm, which can only affect this one spot on the head, and alter it, if it is itself different from what is usual. On this account I call *it* the *determinant* of the relevant skin-spot and hair-group."

"There must be as many of these (determinants) as there are regions in the fully-formed organism capable of independent and transmissible variation, including all the stages of development."

Weismann has no quarrel with epigenesis[2] as a theoretic possibility. The complexity of the germ plasm is to be measured by the amount of independent variability occuring in the parts of the organism. How great this amount is, how many parts are capable of undergoing heritable changes independently of the others is a question to be answered only through extensive observation, but one nevertheless capable, at least theoretically, of being answered.

WEISMANN'S ARGUMENT

Weismann argues with great plausibility that the number of independently

[1] Read before a joint meeting of the zoological section, American Association for the Advancement of Science, and the American Genetic Association, at Stanford University, August 4, 1915.

[2] Older naturalists imagined that a minute but complete embryo must be preformed and incased in either the egg or the sperm. In 1759 C. F. Wolff enunciated the doctrine of epigenesis which, modified by later discoveries, is still accepted by the world of science. As at present understood, it declares that there is no pre-existence of an organism as such, but that the embryo is a new thing created as the result of the union of egg and sperm cells.—THE EDITOR.

heritable variations presented by organisms must be great, because it would be impossible to have complex organs evolving simultaneously, as they obviously have done, unless the improvements in the one did not modify or interfere with improvements in the others. If every variation making toward the perfection of the eye were tied up with a variation in the ear, the organs of digestion, and the structure of the limbs, it seems inevitable that there would be so much interference with one another's progress that any progressive evolution of a number of complex organ systems would be practically impossible. Variations accumulating toward the perfection of any one organ, argues Weismann, would in all probability, work toward the undoing of various other organs. Independent variability of parts must, therefore be assumed in order to make the evolution of a complex organization possible through variation and natural selection.

There is much apparent force in this argument for the conception of the organism as a mosaic product. Its real weight is difficult to estimate, plausible as it may appear, because we know so little of the possibilities of organismal variability. However the assumption of any particular kind of variability may increase or lighten the task of explaining how evolution takes place, it is obviously our first duty to inquire whether or not organisms actually vary in the way alleged. Since so much has been built upon the doctrine of independent variability of parts, the the burden of proof may fairly be held to rest with those who espouse this theory.

Let us therefore consider some of the alleged instances of independent variation. Take the classical case cited by Weismann, of the small pit in the ear which ran through several successive generations. As this is an inherited character, the germ plasm of the person transmitting it must be slightly different from that of a person without this defect. But does it follow that "it can only depend ultimately on a divergently constituted part of the germplasm, which can only affect this one spot on the head, and alter it, if it is itself different from what is usual?"

If variations such as this could come and go, leaving the rest of the organism unmodified, we should be logically led, I believe, to adopt Weismann's conclusion that these variations depend on independent carriers of some sort in the germplasm. Weismann's reasoning is good, so far as his doctrine of determinants goes, if we grant his fundamental assumption. If a small pit in the ear were absolutely the sole hereditary difference between two human beings we might be forced to consider it as a unit character depending on a special determinant, determiner, or other germinal unit or entity. But do we know that the facts are as Weismann assumes?

STUDIES NOT DEEP ENOUGH

I am quite sure that these people with a pit in the ear have never been very critically studied to find whether or not this small character may not be a mere expression of more general differences in constitution. It might very well be that this pit is simply a relatively obvious manifestation of a very slight difference which affects the organism as a whole. The same may be true of the white lock of hair and numerous other characters which appear to vary independently of the rest of the body.

The now neglected study of correlated variability has revealed numerous cases in which what appear as single variations have far-reaching connections. Supernumerary horns in sheep are said by Youatt to go along with great "length and coarseness of the fleece." In mammals in general there is a strong tendency for variation to affect simultaneously hair, teeth and hoofs or claws. Darwin points out that the white star in the forehead of horses is generally correlated with white feet, and that in "white rabbits and cattle, dark marks often co-exist on the tips of the ears and on the feet." Polydactylism, as is well known, tends to affect both hands and feet. How are we to interpret these correlations? If hands and feet vary together do the intervening parts of the skeleton re-

main unaffected? If tip of ears and hind feet show parallel variations in color does it not suggest that we are here dealing with a sort of outcropping of a color variation which is really present, but less conspicuously expressed in other parts of the skin? That bodily changes of a general nature may manifest themselves to ordinary observation in one or at least a very few characteristics is clearly shown in the effects of many diseases. Infectious diseases may have their characteristic symptoms in certain form-changes while leaving the rest of the body apparently unaffected. Hutchinson's teeth[3] in children for instance are the index of a general bodily disease which may have no other very obvious sign.

Introduce some toxin of disease into the body and you produce certain specific characters. Introduce a change affecting all the cells and certain parts only will reveal the fact by noticeable modifications. The appearance of independent variability of parts may thus result from variations that are in reality organismal in their extent. Not only have so-called particular variations not been studied sufficiently to establish the fact that they are really independent, but numerous cases are known in which variations which to casual observations would seem to affect but a single part, are nevertheless correlated with minor changes of wide extent. We contend therefore that the alleged independent variability of parts upon which Darwin, De Vries, Weismann and others have based so much of their argument for the existence of discrete germinal units rests upon an insecure foundation.

INDEPENDENT TRANSMISSION

The question of the independent transmission of characters may be dealt with more briefly. Owing to the independent way in which so-called characters such as tallness and dwarfness, flower color, characters of seed coat and various other parts of peas may be separated and combined almost at will according to the fancy of the breeder it has become customary to look upon these characters as discrete entities borne by discrete elements in the germ cells, and to consider the organism as a mosaic of independently heritable parts. From this viewpoint organisms may be likened to brick buildings in which the bricks may be taken out and replaced by others without materially affecting, except secondarily, the bricks which make up the rest of the structure. But although the facts of Mendelian inheritance are usually interpreted according to the mosaic conception, they do not I believe necessitate the adoption of this standpoint. When the *Anlage*[4] of a green pea is separated from that of a yellow one we are not compelled to assume that something in the germ cell that stands for just greenness is separated from something that is the representative of mere yellowness. We need assume only that what are separated are the *Anlagen* of organisms as wholes possessing the characteristics in question. In other words green and yellow represent organismal variations; expressed in Weismannian terms, green and yellow depend not on determinants, but upon ids, the hereditary bases of whole organisms.

The logical consequence of this standpoint we have presented is that all Mendelian characters are really general and constitutional, however they may appear to be limited to a particular feature of the organism. Many Mendelian characters are quite patently constitutional while others are apparently very limited in their extent like pea and rose comb in poultry. Attention has been so taken up with characters *per se* that I doubt if much careful scrutiny has been given to the possible correlations of characters in other parts of the body. Has anyone for instance very carefully looked for any more general attributes which may be associated with pea or rose comb, or with the smooth and wrinkled coats of peas? Correlations may be difficult to detect, not only for the reasons previously mentioned, but because the

[3] Hutchinson's teeth are a form of incisor teeth indicative of hereditary syphilis.

[4] Anlage is a German term much used by genetists to denote the hypothetical something in the germ-cells which determines the nature of a given part of the adult organism.—THE EDITOR.

associated characters may not improbably have different relations of dominance or recessiveness from that of their more obvious correlates. The question which we have raised can, at least theoretically, be decided by observation and experiment. However it is decided will make little practical difference with most of the problems that confront the investigator in genetics. But there are certain problems of genetics, I suspect, in regard to which it will be found to have an important bearing, although its chief importance is in the way it influences our views on certain fundamental problems of ontogeny and evolution. I can here indicate but a few cases in point:

BEARING ON EVOLUTION

Since I have come to see more clearly the implications of the question I have discussed, I have been surprised to find how many of the difficulties urged against the theory of natural selection disappear when we consider variations as organismal instead of limited primarily to particular parts. Most discussions, I find, consider evolutionary problems from the standpoint of the doctrine of unit characters. How common it is to find speculations as to how this or the other character could have been developed through natural selection, as if each part were somehow separately improved by a series of fortunate survivals. If each character is considered as the summation of a series of variations which primarily concern that character alone, and if the nature of the variations that are integrated is determined by natural selection, we should expect most attributes of an organism to be of a useful kind. If, on the other hand, variations of any one part involve variations throughout the organism, then the preservation of favorable variations in any one organ would of necessity entail changes in other organs which for the most part would probably have no relation to utility. On this view a considerable ingredient of non-adoptive characters would naturally be expected, and it is probable that, through correlation, parts might be evolved to a considerable degree of complexity without having any important use in the life of the organism, provided they did not become positively dangerous to their possessors. Much of the evidence adduced for orthogenesis is what we should expect to find if evolution occurred through the selection of organismal variations. Much of the difficulty about the beginnings of structures and their development up to the point where they acquire selective value would, I believe, also be removed. The wonder is not so much that selection should produce a large amount of what Haeckel would call dysteleological structures, but that it is able to produce (if we grant that it does produce) so much that is so nicely coadapted, and especially that it is able to carry on the simultaneous elaboration and perfection of numerous separate systems of organs.

In these days of attack upon evolutionary problems through direct observation and experiment, I hope I may be pardoned for presenting anything so atavistic as an academic discussion of the method of evolution. But even with our present accumulation of facts bearing on this much discussed problem there is still something to be gained by reflection, and if our reflection suggests new things to look for it will assuredly not be in vain.

How to Make a Eugenical Family Study.

Detailed suggestions to genealogists and others who want to study their ancestry, are contained in Bulletin No. 13 of the Eugenics Record Office, Cold Spring Harbor, Long Island, N. Y., which has just been issued under the title, "How to Make a Eugenical Family Study," and which will be sent to serious inquirers, upon request. It explains and fully illustrates the proper procedure, and also points out at some length the value of a knowledge of the eugenic quality of one's ancestry. Many people have been deterred from studying their family trees biologically, because they did not know how to begin; this bulletin will prove of great help to them.

ILLUSTRATION OF INBREEDING

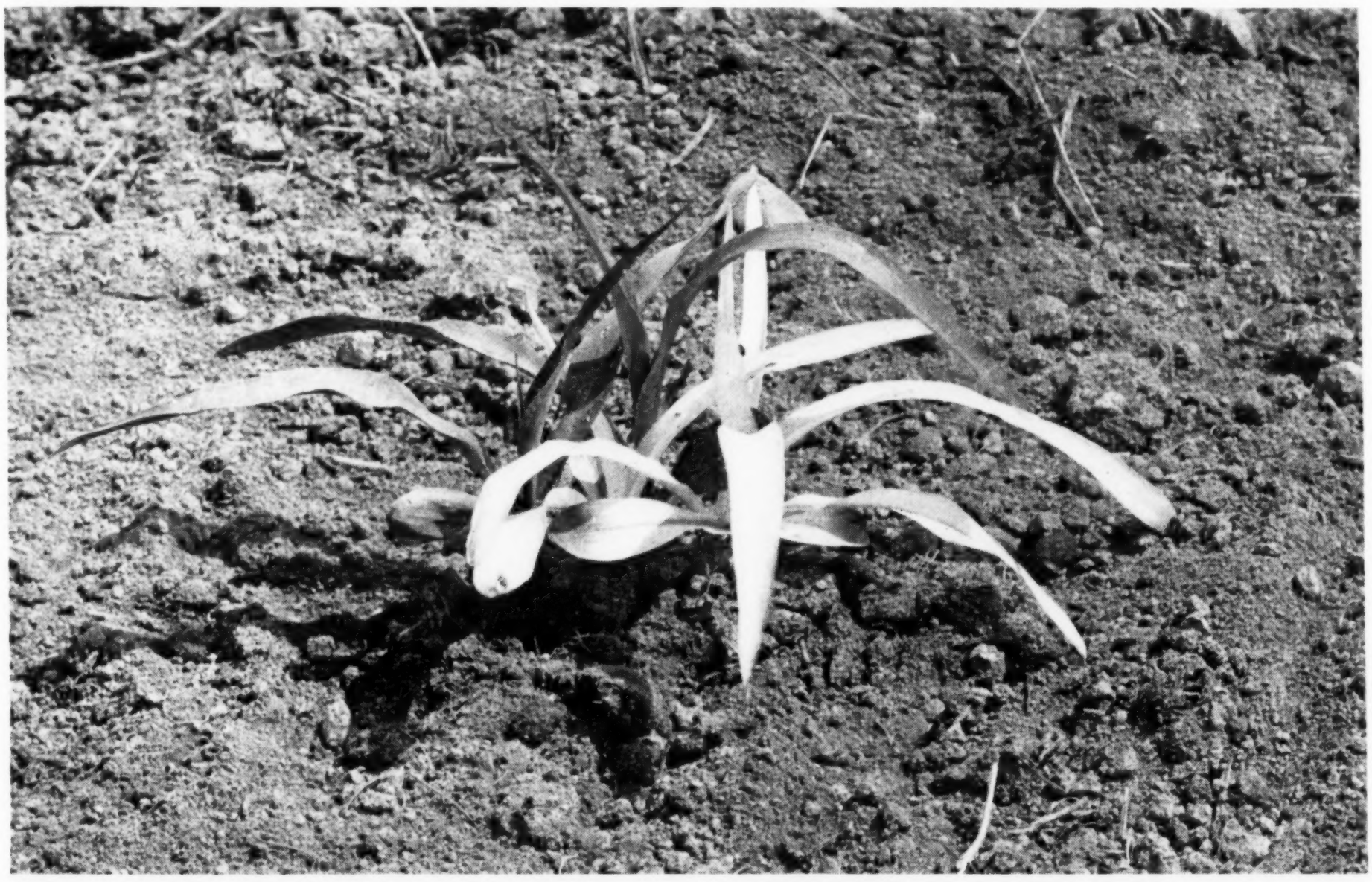
Maize Self-Pollinated for Three Generations Produces One-fourth Albino Plants —Abnormality Isolated and Bred Out of Part of the Stock

D. F. JONES
Plant Breeder, Connecticut Agricultural Experiment, Station, New Haven, Conn.

THE noticeable results attending systematic inbreeding of a cross-bred race of plants are the reduction of vegetative vigor and the isolation of abnormalities. The prejudice against inbreeding is largely due to this latter effect. Inbreeding, however, is the quickest way to make abnormal tendencies visible so that they can be eliminated.

The way in which an abnormality is brought to light by inbreeding is illustrated by a race of Leaming corn which had been self-pollinated for three generations. Two rows of this race in our corn plot this spring produced so many albino seedlings that it was impossible to secure a good stand of plants although an excess of seed was planted.

Albino seedlings in corn are common. Few fields are without a small number of them, but the percentage is so low as to be of no practical effect. Since chlorophyll reduction or albinism in



ALBINO AND NORMAL MAIZE PLANTS

Most fields of Indian corn contain a few albino plants, which lack altogether the chlorophyll or green coloring matter that every plant normally possesses. When a race of plants is inbred, one effect is to accentuate any abnormalities present. Consequently when a race of corn was inbred for three generations, it was natural to expect that the proportion of albinism would be much increased. This photograph shows a hill of Leaming corn grown from seed which had been inbred three generations: it contains three albinos and two normal green plants. (Fig. 10.)

THE PROPORTION OF ALBINOS

There were on hand nine ears representing as many different plants of the inbred maize, and thirty seeds from each ear were planted in a row in a flat, as shown above. Mathematical calculations based on the laws of heredity showed that one-third of these ears should lack the factor for albinism, and produce nothing but green plants; the other two-thirds of the ears should produce one albino plant for every three green plants. The photograph shows the flat with the green plants all cut out: it is observable that one-third of the rows (Nos. 1, 5, 9), as was expected, produced no albinos whatever, while the percentage of albinos in the other rows conformed as closely to expectation as is usual when such small numbers are involved. Row No. 1 was cross-pollinated, as noted in the text. (Fig. 11.)

corn and other plants has been shown to be a simple recessive character,[1] then in an inbred race one-fourth of the plants must be albinos if they occur at all. This large percentage of white plants is quite noticeable in the field.

The numbers secured in this case agree with other published results.[2] The two rows in the field representing two ears from the same inbred race gave 72 white and 232 normal green plants.

There were on hand nine ears, representing nine different plants of this inbred lot which were grown in 1914 from a hand-pollinated, selfed plant in 1913. Two-thirds of these ears should be heterozygous for the abnormality and give albino plants in a three to one ratio. One-third of the ears should give only green plants. About thirty seeds from each ear were planted in a flat. Eight of these nine ears were hand pollinated and selfed. Ear No. 1 was not selfed, but pollinated with a brother plant. The chances that it would show albinos were four out of nine instead of two out of three. It produced only green plants. Of the other eight ears, numbers 5 and 9 gave only green plants as shown in Fig. 11. The remaining six ears gave albino plants as follows:

Number.	Ear Number.	White Plants.	Green Plants.
2	(14-10) 4-6-3	5	19
3	(14-10) 4-6-4	9	13
4	(14-10) 4-6-16	4	21
6	(14-10) 4-6-13	4	15
7	(14-10) 4-6-2	8	15
8	(14-10) 4-6-11	4	25
Total		34	108
Theoretical		35	105

Seed from the original ear of the parent plant, (14-10) 4-6, grown in 1913 which produced the above ears in 1914 gave five albinos out of thirty-five plants grown.

No seed is available of previous generations and no record was made of albino plants occurring in this strain but it is probable that they have occurred each year. It seems safe to say that two of these strains, numbers five and nine, are now free from this abnormality.

[1] Emerson, R. A. "The Inheritance of Certain Forms of Chlorophyll Reduction in Corn Leaves." Nebr. Agr. Expt. Station, Twenty-fifth Annual Report, 1912. See also Miles, F. C., "A Genetic and Cytological Study of Certain Types of Albinism in Maize." Journal of Genetics, January, 1915.

[2] See Emerson and Miles, *loc. cit.*

Production of New Cereals

Grains are systematically bred at the Washington State Experiment Station. With wind and insect pollinated plants, such as maize, rye and the grain sorghums, straight selection is much employed, but with self-pollinated grains such as wheat, oats and barley, hybridization is more used. No selection is made until the second generation, at which time all apparently desirable plants are picked out and planted in triplicate for further tests. The basis for such tests with small grains is the rod row, 150 seeds per row and the rows 18 inches apart. Maize is planted in duplicate rows thirty-six hills long and three stalks per hill. After such a test, the value of any new sort can be determined with a good deal of accuracy.

Plant Breeding in Alabama

Hybridization in cotton and oats has been the principal plant-breeding work of the Alabama Agricultural Experiment Station. Studies of correlation in cotton, conducted under the Adams' Fund, have been in progress for nine years. Studies in correlation are also being made in maize.

REVERSION IN SHEEP

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THOSE familiar with sheep know that the Rambouillet breed, a French improvement on the Spanish Merino, is one of the most highly improved of all sheep. Its color is pure white.

On April 4, 1915, there were dropped in the United States Department of Agriculture experiment flock at Laramie, Wyo., twin ewe Rambouillet lambs. The one was an ordinary lamb in all respects; the other was marked as the accompanying photograph shows—the ventral part of the body, the legs, the lower part of the neck, the face with the exception of a bar between the eyes, and the inside of the ears being black.

The fine-wools have been improved as long and probably breed as true as any of the existing breeds of sheep. Yet this is not the first appearance among them of the pattern here noted. Markings very similar to these have also been seen in black sheep of other breeds. If this color pattern had occurred but once it would have no special significance and could be considered a mutation or sport, but occurring a number of times as it has it suggests the possibility of reversion to the markings of some original forebear, who existed perhaps thousands of years ago.

The markings of the Barbados or woolless sheep are sometimes after this same pattern, and it has been noted in crosses of the Southdown and Barbados too. The Barbados being an unimproved sheep having coarse brown and black hair with a small amount of wool beneath, makes the question pertinent as to whether our improved breeds could have come from a similar type, and whether this character has for the most part been latent during the past several centuries and cropped out only at intervals.

WHITE LAMB'S TWIN

The occasional appearance of this color pattern in highly improved breeds indicates that it may represent the markings of the ancestor of modern domesticated sheep. (Fig. 12.)